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NEPHRITIS IN CHILDREN *

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These investigations were carried out to determine the functional pathology of the nephritides in children. Little data was found in the literature when this work was begun. Since that time Hill [1] has reported on some fairly extensive work along this line. The preponderance of acute over chronic cases in childhood affords an opportunity for the study of the disease at its inception which is unique in civilian practice. All cases of nephritis admitted to the wards were placed in my charge and in this way close cooperation between the ward and the laboratory was maintained.

ETIOLOGY

Infections, often apparently insignficant, were the most important etiologic factors in a series of twenty-six cases.

TABLE 1.—SOURCE OF INFECTION IN TWENTY-SIX CASES OF NEPHRITIS

Disease	Number of Cases	Per Cent.
Tonsillitis	11	42.3
Scarlet fever	4	15.4
Otitis media	3	11.6
Nasopharyngitis	3	11.6
Umbilical infection	1	3.9
Mercuric chlorid	1	3.9
Unknown	3	11.6

The tonsillitis was only revealed by the examination of the tonsils in some cases, no complaint of sore throat having been made. Cultures from the tonsils in two of these cases gave pure cultures of *Streptococcus hemolyticus.*

Blood cultures were made in five cases, in three of which *Streptococcus hemolyticus* was found. Urinary cultures proved of little value, only two out of eleven showing any growth, and in those two cases there was an associated pyelitis.

* Received for publication Nov. 3, 1921.

* From the wards and Pathological and Chemical Research Laboratories, Hospital for Sick Children, and the Department of Pediatrics, University of Toronto.

1. Hill, L. W.: Am. J. Dis. Child. **14**:267 (Oct.) 1917.

A moderate leukocytosis was present in uncomplicated cases. This increase was lymphocytic in character, from 50 to 60 per cent. of the white cells being lymphocytes. A more marked secondary anemia than could be accounted for by the hematuria was present in most cases. The color index was less than one in cases with hemoglobin of 50 per cent. or less, as the number of red blood corpuscles was not reduced to the same extent as the hemoglobin.

An elevation of blood pressure was absent or of moderate degree in most cases. A rise of 120 mm., if maintained, indicated a bad prognosis. These findings agree with those of Berkeley and Lee.[2] The systolic pressure rose to 180, or more, in only two cases of fatal uremia. No relationship between urinary or blood findings and the rise of blood pressure was demonstrable.

The observations of Baginsky,[3] and of Hill[4] on the rarity of cardiac hypertrophy in children with nephritis were borne out in our series. Enlargement of the heart, except as a terminal dilatation, was not seen in any case. The liver was enlarged in 50 per cent. of the cases. The spleen was palpable in six cases.

Eye ground changes are infrequent. Retinal hemorrhages were seen in two fatal cases. Pallor of the optic discs was present in three cases as a part of the general condition. Venous distension around the optic disc was seen in one case. In no instance were the typical retinal changes associated with nephritis seen.

PLAN OF INVESTIGATION

Daily examinations of the urine were made to determine its quantity, specific gravity, presence or absence of macroscopic blood, the amount of albumin (Esbach's method) and the chlorid excretion by the method of Volhard.[5] Frequent microscopic examinations of sediment from fresh specimens was made to study the pathologic constituents.

Chemical examinations of the blood were made from time to time during the patient's stay in hospital. The nonprotein nitrogen, creatinin, and sugar were determined by the micromethod of Folin and Wu,[6] the urea nitrogen by Van Slyke and Cullen's method,[7] and the chlorids were estimated by Rappelye's[8] modification of Volhard's method.

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2. Berkeley, H. K., and Lee, J. W.: Am. J. Dis. Child. **13**:354 (April) 1917.
3. Baginsky: Arch. f. Kinderh. 1902.
4. Hill, L. W.: Am. J. Dis. Child. **17**:270 (April) 1919; M. Clinics N. America **2**:1419 (March) 1919; J. A. M. A. **73**:1650 (June) 1919.
5. Volhard and Harney: Arch. Int. Med. **6**:12, 1910.
6. Folin and Wu: J. Biol. Chem. **38**:81, 1919.
7. Van Slyke and Cullen: J. A. M. A. **62**:1558 (May 16) 1914.
8. Rappelyse: J. Biol. Chem. **32**:509, 1918.

The kidney's ability to concentrate was studied by placing the patient on a dry diet (less than 10 ounces fluid in twenty-four hours) from 6 o'clock the night before the test until its completion, collecting two hour specimens of urine during the day and a twelve hour specimen at night, and determining the quantity and specific gravity of these specimens. In normal children the specific gravity varied at least ten points during the day. The specific gravity of the night urine was usually 1.035.

The diluting and water excreting powers of the kidney were determined by giving a large quantity of water by mouth within a short time, and after emptying the bladder specimens were collected at short intervals. The amount of urine passed in the twenty-four hours, its lowest specific gravity and rate of excretion furnished the desired information. The normal child excreted between 80 and 90 per cent. of the total within four hours, and the whole amount, or more, in twenty-four hours. The specific gravity was as low as 1.001 in some specimens. In the charts, failure to excrete 80 per cent. in the first four hours but excretion of the ingested amount in the twenty-fours hours is marked "delayed;" failure to do either is designated "poor." The lowest specific gravity is indicated.

The elimination of the kidney's normal excretory products was estimated by the daily chlorid excretion on a salt free diet and the response to the ingestion of 5 gm. sodium chlorid. The actual amount excreted and its effect on urinary flow were noted.

The phenolsulphonephthalein test was done after the technic of Rowntree and Geraghty,[9] with the exception that when much edema was present the drug was given intravenously, at other times intramuscularly. The normal response to this test in children is the excretion of from 60 to 75 per cent. of the drug in two hours.

CLASSIFICATION OF CASES

Our series was divided into three main groups of cases: (1) the acute, comprising twenty-four cases; (2) chronic glomerulonephritis, two cases, and (3) nephrosis, one case. The acute cases were further subdivided into those in which progress toward recovery was rapid and steady, and those which tended to become chronic, i.e., into resolving and nonresolving groups. Those cases which terminated fatally are treated in a section by themselves.

1. *Acute Resolving Nephritis.*—Fifty per cent. of the acute nephritides fell into this group. Admission to the hospital usually occurred during the first week of the disease; some cases, however, were further advanced. The usual history was that of an acute upper

9. Rowntree and Geraghty: J. A. M. A. **67**:811, 816 (Sept. 2) 1911.

TABLE 1.—Acute Cases; Recovery

Name, Age, Date of Admission	Day of Disease	Temperature	Edema	Eye-grounds	Urine					Blood Pressure		Concentration Test	Water Test	Phenol-sulphone-phthalein	Added NaCl	Blood					
					Amount	Specific Gravity	Albumin	Chlorids	Mac. Blood	Systolic	Diastolic					Non-protein N	Urea N	Uric Acid	Creatinin	Sugar	Chlorids
1. W. L.	32	100	++	N	750	1.012	0.2	....	++	125	90	.....	.....	.....	.....	46.2	25.5	1.9	3.7	0.14	0.63
5 yrs.	33	98.9	+	..	268	1.020	....	....	+++	...	...	1017-1038									
10/22/19	36	98	+	..	456	1.012	....	....	++	...	...	.....	Delayed 1005	39.8							
	38	..	+																		
	40	..	..	..	594	1.020	....	3.05	++	...	...	.....	.....	.....	Poor						
	46	98	+	..	940	1.018	0.08	1.03	++												
	52	98	+	..	700	1.020	0.08	1.26	++	105	85	.....	.....	29.4							
	78	98.4	+	..	700	1.028	0.01	2.8	0	...	...	.....	.....	.....	.....	30.8	18.0	1.6	3 4		
	79	98	0	..	1,000	1.018	0	2.0	0	...	...	.....	Good 1002								
	80	..	0	N	860	1.023	0	4.3	0												
	82	98	0	..	900	1.022	0	3.1	0	...	...	.....	.....	58.4							
	84	..	0	..	824	1.026	0	2.8	0	...	...	1016-1030									
	85	..	0	..	940	1.023	0	7.0	0	...	...	.....	.....	.....	Good						
2. P. C.	36	98.4	+	N	194	1.030	....	....	0	105	80	1025-1030	.....	.....	.....	30.1	25.0	2.2	2.9	0.09	0.56
4 yrs.	42	98.6	+	..	.....	.....	....	....	..	...	...	.....	.....	38.3							
11/13/19	43	..	+	..	400	1.017	0.09	....	0	...	...	.....	Poor	30.3							
	57	..	0	..	500	1.020	0.08	0.84	0				1003								
	67	98	0	..	600	1.030	0.30	2.97	0	...	...	.....	.....	.....	.....	30.8	22.0	...	1.1		
	85	..	0	..	500	1.030	0.13	7.80	0	...	...	.....	.....	.....	Good						
	87	..	0	..	764	1.028	0.15	4.2	0	...	...	.....	Delayed								
	90	..	0	..	600	1.027	0	3.8	0	...	...	1017-34	1002								
	110	..	0	N	630	1.028	0	3.6	0	...	...	.....	.....	60.2							
3. E. R.	23	98	+	N	246	1.020	0.5	....	0	105	84	1020	.....	.....	.....	84.0	49.0	3.0	3.0	0.089	0.55
5 yrs.	26	..	..	..	474	1.015	0.4	1.09	0	...	...	.....	Slow	20.3	Fair						
11/11/19	27	..	..	..	800	1.020	0.02	4.64	0				1008								
	41	..	..	..	.....	.....	....	....	..	...	...	.....	.....	62.5							
	42	..	..	..	474	1.020	0	3.6	0	...	...	1008-1020	.....	.....	.....	40.0	28.0				
	50	..	..	..	1,010	1.010	0	2.2	0	...	...	.....	Good 1005								
4. A. M.	13	99	+	N	480	1.028	0.5	....	+	110	90	.....	.....	22.5							
8 yrs.	19	98	..	..	872	1.020	0.5	....	+++	...	...	.....	50% in 4 hours								
12/5/19	21	..	..	..	360	1.025	0	3.77	0	...	...	1018-1028	90% in 24 hours	40.0	.....	32.8	21.3	2.2	1.05	0.090	
5. R. C.	3*	99	+	N	.....	.....	....	....	..	116	85	.....	1010	22.0							
8 yrs.	4	98	+																		
10/20/19	111	98	+	..	390	1.032	0.25	3.12	0	102	80	.....	Good	.....	... ..	58.3	23.1	5.1	1.30	0.108	0.60
	115	98.6	0	..	240	1.041	0.20	2.13	0	...	...	.....	1002	.....	Poor						
	120	98	0	..	468	1.030	0	4.07	0	...	...	1013-1037	.....	.....	Fair						
	124	98	0	..	240	1.037	0	1.46	0	...	...	.....	.....	68.0							

6. B. S.	5	98.6	+	.	300	1.022	1.0	0.06	+++	100	85	.....	.....	60.0	.....	31.8	25.0	8.3	3.82	0.100	0.77
5 yrs.	20	..	..	..	500	1.025	0	1.00	0	...	...	1020-1030	.....	65.0							
5/26/21	24	..	..	.	650	1.022	0	1.40	0	...	...	.....	Good 1004								
7. R. H.	3	104	+	N	600	1.020	3.0	....	++	118	90	.....	.....	.....	.....	84.02	72.0	10.0	4.02	0.092	0.60
11 yrs.	21	98.6	0	..	420	1.030	0.15	1 80	0	...	...	.....	.....	24.2	.....	51.9	....	3.3	2.17	0.09	0.572
3/5/20	24	..	0	..	383	1.025	0.40	1.47	0	...	...	1021-1030									
	26	98	0	..	600	1.022	0.02	6.12	0	...	...	.....	.....	59.8	Good						
	30	98	0	..	825	1.022	0	3.18	0	100	85	.....	Good 1004								
8. N. M.	7	98	+	N	690	1.018	0.20	0 384	0	100	80										
9 yrs.	20	98.6	0	..	630	1.018	0	0.400	0	...	...	.....	.....	43.3	.....	27.2	18.9	1.8	1.4		
11/11/20	22	98	0	..	570	1.027	0	0 3 8	0	...	...	1016-1030									
	24	..	0	..	1,350	1.012	0	1 64	0	...	...	.....	Good								
	26	..	0	.	900	1.015	0	5.68	0	...	...	.....	1005	.....	Good						
9. J. C.	30	99	+	N	390	1.014	0.40	1.88	+	...	...	.....	.....	63.3	.....	42.2	35.0	5.5	1.4	0.110	0.695
11½ mos.	36	..	..	..	480	1.012	0.20	0 876	0												
11/5/20	40	98	0	..	475	1.013	0	1.20	0	...	...	....	.....	65.0							
10. S. L.	2†	104	+	..	250	1.017	3.75	0.075	+++	110	80	.....	.....	.....	.....	102.0	92.0	2.5	2.0	0.106	
12½ mos.	14	..	..	..	560	1.014	2 00	0.210	+												
2/10/21	24	98	..	..	570	1.020	3.0	.....	0	...	...	.....	.....	30.0							
	25	..	..	..	380	1.020	3.0	0.855	0	...	...	1010-1020									
	34	98	..	..	1.020	1.015	1.3	1.710	0	...	...	.....	Good	.....	Good						
	50	98	..	..	660	1.019	1.0	6.41	0				1005								
	58	98	..	N	700	1.020	0	3.10	0	...	...	....	.....	50.0	.....	30.2	18.0				
11. M. R.	7	98.8	0	..	. ....	1.007	1.0	0.85	0												
2 wks.	10	..	..	..	.....	1.006	0.5	0.78	0	...	...	.....	.....	.....	.....	39.1	31.4	3.2	1.6	0.083	0.58
12/30/20																					
12. J. B.	5	99	++		. ...	1.023	+++	....	0												
8 yrs.	6	98.6	+	N	770	1.018	1.3	3.92	++	100	80										
11/26/20	28	..	..	..	640	1.020	1.25	1.424	++	...	...	.....	.....	.....	.....	44.7	38.0	4.1	3.3	0.091	
	33	98	+	..	890	1.010	1.50	5.69	+	...	...	1012-1023	.....	.....	Good						
	36	98	0	..	1,675	1.010	0.20	1.62	+	...	...	.....	Good	42.0							
	40	..	0	..	700	1.020	0.2	1.63	0				1004								
	51	..	0	..	810	1.017	2.0	1.68	0												
	80‡	..	0	..	1,210	1.018	0.6	2.65	0												
	81	..	+	..	250	1.017	1.5	0.075	+++												
	95§	98	0	..	930	1.021	2.0	2.19	0												
	96	98	0	..	545	1.023	1.0	2.0	0	...	...	1020-1025									
	120	98	0	..	1,200	1.021	0	1.8	0	...	...	.....	.....	50.0	.....	32.3	18.9	...	2 9		

* K. L. † Scarlet fever, erysipelas. ‡ K. L. (51). § Varicella (81).

respiratory tract or tonsil infection, followed in a day or so by more or less complete suppression of urine, which was succeeded by hematuria. Slight edema of the lower eyelids and about the ankles was common, but in only two cases was there general anasarca. The edema usually disappeared within ten days, unaccompanied by marked diuresis, but with a persistently increased excretion. Opthalmoscopic examination was made in each case but nothing abnormal was seen. Only two cases, (Cases 1 and 7, Table 1), showed any increase in blood pressure, and in both cases it fell to normal when the edema disappeared. The only elevation of temperature (Case 10) occurring was due to the initial infection and fell to normal when it subsided. The hematuria usually persisted from two to four weeks, and showed a tendency to recur following tonsillectomy or the administration of an irritant, e.g., sodium chlorid. The average stay in hospital was two months, varying from two weeks to four months in individual cases. The patient was not discharged until all evidence of kidney inflammation had subsided. Five (Cases 3, 4, 5, 10 and 11), of these children have been seen at the nephritic clinic since their discharge. Four show no evidence of nephritis in either the blood or urine and are apparently in good condition physically.

Functional Studies.—The initial low excretion of urine was replaced by a normal output within two weeks. Albumin, to the extent of 1 or 2 gm. per liter, was present during the first week or two, after which it fell to a trace which usually persisted long after other evidences of trouble had disappeared. The excretion of chlorid on a salt free diet was good, and additional salt in the diet, when the acute symptoms had subsided, was promptly eliminated by an increased concentration of the urine. The administration of the sodium chlorid in two of the cases resulted in a reappearance of the hematuria. Microscopically, the urine contained blood cells and large mononuclear cells. Casts were only evident at first when the numerous red blood cells were laked, causing the appearance of an apparent increase in casts as the hematuria cleared up. The casts were chiefly finely granular and hyalin, few blood casts being seen, even when the urine contained much blood.

The phenolsulphonephthalein test proved of little value until all acute symptoms had subsided, being as low as 22 (Case 3) and as high as 60 (Case 2) in cases otherwise comparable. When the disease became quiescent, the phenolsulphonephthalein excretion usually rose to normal. Transitory hematuria followed the giving of the drug in two cases.

Impairment of the kidney's ability to concentrate was noted in only one case of this group at the time of discharge. Some fixation at a

TABLE 2.—Acute Cases of Nephritis Becoming Chronic

Name, Age, Date of Admission	Day of Disease	Temperature	Edema	Eye-grounds	Urine					Blood Pressure		Concentration Test	Water Test	Phenolsulphonephthalein	Added NaCl	Blood					
					Amount	Specific Gravity	Albumin	Chlorids	Mac. Blood	Systolic	Diastolic					Non-protein N	Urea N	Uric Acid	Creatinin	Sugar	Chlorids
1. N. M.	14	98.8	+++	N	520	1.024	2.8	0.052	0	102	70	.....	.....	19.4	.....	40.3	23.5	1.8	1.5	0.108	0.60
5 yrs.	24	98.6	++	..	243	1.030	....	....	..	115	80	Fixed									
10/9/19	27	98	+	..	660	1.026	....	....	..	...	...	1030	Delayed								
	61	98	0	N	600	1.024	1.0	2.28	0				1002								
	63	..	0	..	640	1.021	0.8	4.48	0	...	...	.....	.....	70.0	Poor	18.4	13.4	...	1.6		
	67	..	..	..	415	1.028	1.5	2.19	0	...	...	1026-1040									
	89	98	0	N	460	1.032	0.25	3.53	0												
2. O. L.	14	100	++	N	200	1.015	1.00	....	++	100	80										
12 yrs.	18	98	+	..	.....	.....	....	....	..	...	...	.....	.....	13.0	.....	38.5	18.4	...	4.02	0.100	
11/30/20	22	99	+	..	250	1.014	0.80	2.13	+	...	...	.....	.....	.....	Poor						
1/ 3/21	412	98.8	0	N	450	1.023	1.0	....	0	...	...	.....	.....	40.0	.....	30.0	18.0				
3. J. P.	7	99.8	++	..	.....	.....	....	....	..	140	95										
10 yrs.	15	99	+	..	.....	.....	....	....	..	122	78	.....	.....	79.1	.....	137.0	71.6	...	5.02	0.12	0
11/24/19	17	..	+	..	600	1.020	1.5	....	++	...	...	Fixed									
	24	98	..	..	840	1.015	1.0	2.57	+	...	...	1020	Good								
	25	98	0	..	570	1.020	0.5	4.85	+				1000								
	26	98	0	..	540	1.020	0.5	2.16	+	...	...	.....	.....	.....	Good						
4. E. B.	70	98.6	0	..	760	1.015	2.2	1.748	++	110	65	.....	.....	50.0	.....	63.0	40.0	...	1.37	0.047	0.60
14 yrs.	74	..	0	N	650	1.014	1.5	0.682	++	...	...	1012-1017									
3/3/21	76	..	0	..	472	1.013	2.0	0.531	++	...	...	.....	Delayed								
	82	98	0	..	1,150	1.012	3 8	....	+	...	...	.....	1004	.....	Poor						
	86*	98.6	0	.	900	1.012	0.2	1.59	0												
	96	99.8	0	..	870	1.016	3.2	0.48	+++	...	...	.....	.....	60.0	.....	38.0	20.0	...	1.3		
	100	98	0	..	860	1.013	0.2	....	0												
5. M. C.	15	99.4	+++	..	600	1.013	4.5	....	+++	145	118	.....	.....	17.9	.....	49.8	40.2	3.9	1.66	0.109	0.465
13 yrs.	27	100	++	..	825	1.015	2.0	0.68	++												
12/7/20	31	98	+	..	569	1.016	1 2	1.47	++	...	...	1012-1021									
	34	101	+	..	840	1.015	0.8	5.75	++	...	...	.....	.....	.....	Good						
	49	102	+	..	800	1.015	0.5	....	+	...	...	.....	.....	20.0	.....	57.7	30.0	...	1.2		
	58	98	0	..	1.060	1.010	0.3	1.77	0	...	...	.....	Delayed								
	60	..	0	..	500	1.021	0.4	1.80	0	...	...	1020-1021-1005									
6. E. S.	42	99	0	..	980	1.015	1.0	0.98	++	...	...	.....	.....	12.5	.....	36.9	29.8	2.27	1.15	0.11	
7 yrs.	46	99.2	0	..	420	1.018	1.8	0.96	+	110	80	1015-1019									
2/11/21	55	100	0	..	665	1.010	0.5	0.80	0	...	...	.....	Good								
	57	98.6	0	..	760	1.013	2.0	1.795	0	...	...	.....	1003	.....	Poor						
	58	98	0	..	750	1.013	1.5	0.806	0	...	...	.....	.....	28.0							

* K. L.

high level was observed during the acute stage in two cases (Cases 1 and 8).

Early in the disease the ingestion of a large amount of water was not usually followed immediately by any marked diuresis, but even at that time the entire amount was excreted in the first twenty-four hours. After recovery from the acute symptoms, water excretion was normal. In only one case (Case 8) of this group was the water retained with resulting increase in the edema. In this case the kidney's ability to excrete water remained impaired.

Only slight increase in the nonprotein nitrogen constituents of the blood at any stage of the disease was seen in these cases. The only exception to this was in a child (Case 10) with lobar pneumonia, when it was as high as 84 mg. per hundred c.c., but coincidentally with the fall in temperature it became normal. A relative increase in the urea nitrogen to 65 or 75 per cent. of the total nonprotein nitrogen, in place of the usual 50 per cent., was common. The creatinin never rose above 3 mg. per hundred c.c., and in most instances remained below two. No deviation from the normal blood sugar content was observed. The plasma chlorids were normal in all but one case (Case 6) with a slight but persistent edema.

2. *Acute Nonresolving Nephritis.*—Six cases (Table 2) presented evidence of being a more severe type of the disease than those of the last group. Admission to the hospital varied from one to ten weeks, usually two, after the onset of the disease. The severity of the acute symptoms had not abated at this time. Fever, without apparent exciting cause, was common. The hematuria tended to be periodic, and was generally present, at times for two months or longer. Well marked edema or anasarca of a persistent type was usual. The edema lasted five or six weeks, and later was easily produced by a slight infection or by dietetic errors. A rise in blood pressure, slight but maintained over weeks, was noted in all but one case (Case 2). Congestion of the retinal vessels was the only pathologic change found in the eyegrounds, and this occurred in only two cases (Cases 5 and 6). Severe secondary anemia was present in all cases. Only one patient (Case 5) of this group is attending the outdoor clinic now, one year after the acute attack. She is below par physically and still has albuminuria and cylindruria.

The functional studies furnished earlier indications of the severity of these cases than was obtainable by clinical observations. The reestablishment of normal urinary secretion was later than in Group 1. The urine contained more albumin—usually 3 or 4 gm. per liter during the first few weeks. Traces persisted during the entire stay in hospital. Daily chlorid excretion and the response to the ingestion of extra

TABLE 3.—Cases of Chronic Nephritis

Name, Age, Date of Admission	Day of Illness	Temperature	Edema	Eye-grounds	Nycturia	Urine					Blood Pressure		Concentration Test	Water Test	Phenolsulphonephthalein	Added NaCl	Blood					
						Amount	Sp. Gr.	Albumin	Chlorids	Mac. Blood	Systolic	Diastolic					Non-protein N	Urea N	Uric Acid	Creatinin	Sugar	Chlorids
1. M. G.	10	101	+	Edema	+	1,200	1.015	0.8	1.14	Hb.	100	80	.....	.....	50.0	.....	70.4	59.8	6.8	2.8	0.086	0.60
5½ yrs	12	99	0	of disks	..	1.207	1.016	1.0	0.995	Hb.	...	...	.....	Good 1007								
1/2/21	14	...	0	.....	..	872	1.018	0.2	2.11	0	...	...	1018-1020	.....	.....	Poor						
	20	98.6	0	.....	..	1,035	1.010	0.25	2.35	0	...	...	.....	.....	68.3	.....	34.2	....	...	1.3		
	60	98	0	.....	..	455	1.020	0.10	1.47	0	...	...	1019-1025									
	70	...	..	....	..	100	1.020	0	1.87	0												

chlorids was poor, and usually caused the return of edema. Hematuria followed the salt test in two instances. Microscopic findings were as in Group I at first but differed in the degree and persistence of the cylindruria.

Phenolsulphone phthalein excretion was uniformly low early in the illness and frequently remained low after all acute symptoms had subsided.

Some impairment of the ability to concentrate was constantly present. Fixation of the specific gravity was usually at a high level—1.020. A relative fixation, variation of four or five points, and inability to raise that of the night urine to 1.030, was the rule.

The response to the ingestion of large amounts of water was its gradual elimination during the whole twenty-four hours. The diluting power of the kidney was only slightly below normal. Two cases showed no deviation from the normal (Cases 3 and 6). Both patients were children who had less edema than the others of the group.

The blood examination was of less value in determining the prognosis than the other functional tests, the results obtained being much the same as in Group I. The higher creatinin values found in two cases (Cases 2 and 3) were the only exception to this rule.

Chronic Cases.—Only two cases of chronic nephritis were encountered in this series (Table 3). One of these patients (A. J.) died as a result of an acute nephritis superimposed on the chronic condition, and is considered with the fatal cases. In the other case, an attack of pharyngitis was followed in two days by the passage of bloody urine, which was not diminished in amount. Examination proved the discoloration to be due to hemoglobin and not whole blood. Microscopically, the urine differed from that of the acute cases in the absence of much blood and large mononuclears, and in the presence of large numbers of all kinds of casts. The fatal case, mentioned above, also showed numerous casts in the urine. The child passed large amounts of pale urine; half of the total amount was voided during the night. The edema cleared up quickly. The blood pressure and eyegrounds were both normal. Secondary anemia was marked. Functional derangement was most evident in the greater increase in the noncolloidal nitrogen of the blood, the inability of the kidney to concentrate, or to excrete satisfactorily added salt in the diet. Water excretion was good, but there was some failure in the diluting power of the kidney.

Fatal Cases.—Seven cases of our series terminated fatally. One of these (W. S.) was a case of nephrosis following the administration of calomel over a period of one week. Septicemia was the immediate

TABLE 4.—Fatal Cases of Nephritis

Name, Age, Date of Admission	Day of Disease	Temperature	Edema	Eye-grounds	Urine					Blood Pressure		Concentration Test	Water Test	Phenolsulphonephthalein	Added NaCl	Blood					
					Amount	Specific Gravity	Albumin	Chlorids	Mac. Blood	Systolic	Diastolic					Non-protein N	Urea N	Uric Acid	Creatinin	Sugar	Chlorids
1. A. W.	60	99	+++	N	400	1.010	0.10	....	0	105	80	.....	.....	24.2	.....	34.5	22.4	1.2	0.90	0.099	0.58
9 yrs.	90	98	++	..	1,000	1.020	0.25	....	0												
11/10/19	91	98	+	..	381	1.020	....	....	0	...	...	1018-1022									
	93	98.4	+	..	458	1.016	....	....	0	...	...	.....	Poor								
	110	98.8	+	..	550	1.021	1.05	2.52	0												
	115	99	+	..	670	1.020	1.20	2.04	0												
	116	99.1	+	..	800	1.016	1.20	3.20	0	...	...	.....	.....	.....	Poor						
	117	98.6	+++	..	760	1.019	1.20	....	0	...	...	.....	.....	8.3							
	137	99.2	+++	..	340	1.020	0.30	0	0	...	...	.....	.....	.....	.....	73.9	59.6	...	2.1		
	140	99	+++	..	50	1.013	0.18	0	0												
	142	99.2	+++	..	0	0	0	0	0	...	...	.....	.....	10.0							
	145	98	+++	..	40	1.015	0.90	0.004	+												
	148	97.2	+++	..	0	0	0	0	0												
	149	96	+++	..	0	0	0	0	0												
	152*																				
2. M. B.	45	99	+++	NN	.....	.....	....	....	..	125	90	.....	.....	16.6	.....	173.0	158.6	...	8.01	0.125	0.625
8 yrs.	47	98.6	+++	..	510	1.021	0.35	0.816	++												
12/7/19	48	100	+++	..	535	1.020	0.50	0.856	++	...	...	1019-1021									
	51	99	++	..	582	1.013	0.50	1.830	+	...	...	.....	Poor	.....	.....	221.0	181.0	0.13	4.20	0.11	0.56
	55	98.6	+	..	510	1.020	0.40	1.82	0												
	75	98.6	+	..	390	1.020	0.02	1.13	0	...	...	.....	.....	.....	Poor	131.0	100.0	3.0	3.3		
	86	99	++	..	452	1.017	0.45	0.497	0	...	...	1016-1017									
	96	98	++	..	330	1.017	0.40	0.99	0	...	...	.....	.....	0	.....	231.0	180.0	4.3	12.06		
	98†																				
3. M. S.	10	..	+++	N	.....	.....	....	....	..	...	...	.....	.....	20.8	.....	46.2	30.0	7.35	0.46	0.082	0.459
9 mos.	12	100	+++	..	30	1.014	0.50	....	++												
3/25/21	13	99	+++	..	30	1.015	0.55	0	++												
	102‡																				
4. A. W.	4	..	..	..	.....	.....	....	....	..	...	...	.....	.....	18.0	.....	39.5	31.0	3.0	1.5	0.091	0.44
2 wks.	7	+	+	..	35	.....	0.03	0.0108	0												
1/1/21	8	..	..	..	42	1.026	0.02	0.0308	0												
	9§																				
5. A. J.	3	99	+	..	.....	.....	....	....	..	...	...	.....	.....	.....	.....	73.0	60.0	2.9	1.40	0.10	
9½ yrs.	4	98.6	+	..	380	1.018	0.20	0.209	+	140	90										
2/9/21	7	100	+	..	250	1.024	0.80	0.30	0												
	9	99	++	..	310	1.022	0.70	0.209	+	180	100	.....	.....	.....	.....	99.0	89.6	4.2	1.42	0.086	
	11	..	++	..	160	1.020	0.72	0.06	0												
	12*																				
6. D. P.	6	101	..	..	0	0	0	0	0	...	...	.....	.....	.....	.....	126.0	112.6	3.6	1.7	0.20	
3½ yrs.	9	103	..	..	?	0	0	0	0	...	...	.....	.....	.....	.....	124.0	.....	...	1.6	0.14	
2/22/21	11	...	..	..	.....	1.010	0.0	0	+	...	...	.....	.....	.....	.....	126.0	.....	2.59	1.69		
	16*																				
7. W. S.	14	100	+++	..	.....	1.010	0.85	0	0	...	...	.....	.....	.....	.....	28.8	21.0	...	3.3		
16 mos.	15¶																				
2/3/20																					

* Died. † Died at home one day after removal from hospital. ‡ Died at home following general convulsions and anuria.
§ Died after convulsion. ¶ Died suddenly

cause of death in two cases (Cases 1 and 6). One child (A.W.), aged 2 weeks, was admitted because of muscular twitchings and was believed to have had a cerebral hemorrhage. This infant passed very little urine, and it contained both blood and casts. Its nasopharynx was markedly congested. Necropsy revealed the presence of inflammatory changes in the kidneys and the absence of any intracranial lesion.

Temporary improvement was noted in most of these cases. Relapses were frequent and of increasing severity. The blood pressure was raised in the four cases in which it was taken. One child (A. J.) with an acute nephritis superimposed on a chronic nephritis died with uremic convulsions and had a blood pressure of about 200 during the last week of life. Retinal hemorrhage was seen in two cases.

Functional Studies.—Early indications of the bad prognosis in this group were furnished by the response of the kidney to functional studies. Early fixation of the specific gravity and failure to concentrate was seen. The specific gravity was usually fixed at 1.018 or 1.020 at first, but showed a constant tendency to become more rigidly fixed at a lower level as the disease progressed. Failure to excrete large amounts of water, even in the twenty-four hours, was present in all cases. Uniformly lower excretion of phenolsulphonephthalein was found.

The creatinin nitrogen gives the most valuable indication of prognosis. The other nonprotein nitrogen bodies were increased but not to such an extent as to warrant giving a fatal prognosis. The high creatinin value in one case (M. B.) was first obtained during a period of clinical improvement.

Little time was allowed for work on the case of nephrosis, as the child died suddenly within twenty-four hours of admission. He was admitted with general anasarca and the history of its having developed subsequent to the administration of calomel. At its onset, the urine was found to contain much albumin but few cellular elements. At the time of coming to hospital, two weeks later, the albumin was less in amount and a few blood cells and casts were present. Typical nephrotic changes were seen in the sections of the kidney.

PATHOLOGY

The pathologic data were obtained from the five fatal cases which came to necropsy. Three cases of nephritis, one case of chronic nephritis and one case of nephrosis were in this number.

1. *Acute Cases.*—In the gross, these kidneys were deeply congested and slightly enlarged. The glomeruli stood out as minute points above the surrounding tissue. Histologically, the most striking changes were seen in the glomeruli, which were swollen, congested and the seat of

cellular proliferation. The tubules contained much blood and some casts. Degenerative changes in the tubules, particularly the proximal convoluted portion, were present. Evidence of early fibrotic change was noted in all cases. The interstitial tissue showed little abnormality.

2. *Chronic Cases.*—The kidneys were larger than normal. The surface was finely granular. Histologically, inflammatory changes in all stages were seen. Some portions of the kidney showed scarring with fibrosed glomeruli, flattened and degenerated tubular epithelium, while in other areas there was an acute intracapillary glomerulitis, with little or no scarring. Cellular proliferation in the interstitial tissue was more marked than in the acute cases. The patient, whose kidneys are described above, had had scarlet fever four years previously and was admitted to the hospital this time suffering from acute nephritis. A history of nycturia during the interval, and the passage of an unusually large number of casts in his urine was the only way in which he differed clinically from other cases of acute nephritis.

3. *Nephrotic Case.*—The kidney was only slightly enlarged, somewhat pale in color, the cut edges rolled out and the cut surface presented a mottled appearance, due to the presence of greyish areas. Histologically only slight inflammatory changes were seen in the glomeruli. Extensive tubular degeneration was present. The cells of the proximal convoluted tubules were flattened. Cellular debris filled many tubules. The intersititial tissue was a little oedematous.

PROGNOSIS

The prognosis in nephritis in childhood must be based on a consideration of all available data, both clinical and laboratory. In our series of cases, 50 per cent. of the patients have recovered without any evident impairment of renal function or general health. This statement is based on the condition of some of these children who attend the outpatient nephritic clinic nearly a year after their illness.

Clinically, the presence of marked edema, or the persistence of slight edema longer than a month, indicates a severe lesion. The amount of blood in the urine seems of little significance but its persistence a month or longer, or its easy return following slight infections or the taking of salt in the food, demands consideration. Patients with frequent relapses do poorly. A moderate rise of blood pressure, if maintained, is a bad omen.

Functionally, the fixation of the specific gravity and poor excretion of phenolsulphonephthalein after the disease becomes quiescent, furnish the most reliable guides to prognosis. Fixation at a high level, 1.020 or more is of less serious import than fixation at a low level. The excretion of 50 per cent., or less, of phenolsulphonephthalein in two hours was considered low.

Determination of the nonprotein nitrogen of the blood proves valuable in some cases. High creatinin appeared to be the most certain evidence of severity, 3 mg. per hundred cubic centimeters indicating a severe lesion, while cases with 5 mg. or over ended in death. Increase in the other constituents after symptoms of the disease had passed, were of value, but if they were only raised during the acute stage of the disease they were of little value in prognosis.

The elapse of sufficient time to determine the development of a chronic nephritis in those cases showing a tendency that way, has only occurred in two cases. These two patients attend the outdoor now because they are below par physically. The urine still contains small amounts of albumin, blood cells and granular casts. Secondary anemia is still present.

In the fatal cases, functional studies indicated the outcome before clinical symptoms did.

TREATMENT

On admission to hospital patients were put to bed and remained there in most cases until all evidences of acute nephritis had disappeared. The diet was restricted to 1,000 or 1,600 c.c. milk, depending on the age of the child. Milk was well tolerated in most cases and furnished a salt and fluid poor diet with insufficient protein to cause any increase in the nitrogenous constituents of the blood. Fluid intake was limited to 1,600 c.c. at the most, the large part being made up of milk. A more liberal diet, consisting first of cereals and milk puddings, and later vegetables, was given as soon as retained waste products were excreted. Protein was added gradually, when the disease became quiescent, until a maximum of 40 or 50 gm. was given when the patient was clinically cured. Fish or chicken first, later eggs and meats were allowed on alternate days. The diet was kept "salt free" throughout the stay in the hospital, and salt was allowed later only if the response to the additional chlorids had been satisfactory, and productive of no edema or hematuria.

The work of Howland and Marriott [10] on phosphate retention as the cause of acidosis in nephritis, and the favorable reports of the administration of calcium salts on nephritic edema by Hülse,[11] led us to use calcium chlorid or lactate, in 5 gm. doses, four times a day, in the hope of influencing favorably those two symptoms. Edema apparently clears up more rapidly when either of these drugs is given. The lactate seems superior to the chlorid. Few of our cases gave clinical evidence of acidosis, and no difference was noted in this respect

10. Marriott and Howland: Arch. Int. Med. **18**:709 (Dec.) 1916; Arch. Int. Med. **22**:477 (Oct.) 1918.

11. Hülse: Centralbl. f. Inn. Med., Leipzig, **41**: No. 25, 1920.

whether calcium salts were given or not. Stimulation of diuresis by the administration of small doses of digitalis was tried in a number of cases without beneficial results.

Hot packs were used at first, but the small loss of water determined by weighing the patient before and after, and the evident depressant action on the patient, led us to discard their use later. Hot stupes to the lumbar region appeared to be equally effective and less disturbing to the patient.

Exsanguination transfusions were done in two cases of uremia. In one of these cases complete suppression of urine had existed for four days previously and urinary flow was reestablished after the transfusion. Delay in getting a suitable donor for the other patient allowed him to become moribund before the operation so that the fatal outcome was not averted. Simple transfusion, done in two cases, proved the most effectual remedy for the ever-present secondary anemia.

DISCUSSION

Cases of acute nephritis in childhood may be divided into those cases in which apparently complete recovery ensues after from three to five weeks, and those cases in which improvement occurs for a time and then the conditions remains in statu quo; in other words, the resolving and the nonresolving types. This latter type frequently terminates fatally following a relapse or some intercurrent infection. Functional tests differentiate cases into these groups earlier and more surely than do clinical observations.

Hematuria.—Microscopically, blood was found in all cases. It was present in large amounts in the majority of instances. A tendency to recurrent hematuria was seen in a number of cases, and when present furnished contraindication to the phenolsulphonephthalein test, as this drug usually induced an attack. In three cases tonsillectomy caused the reappearance of this phenomenon. Hemoglobinuria, associated with the presence of a reducing body in the urine, was noted in two cases (M. G. and A. J.) without apparently any special significance. The blood sugar was normal in both patients.

Edema.—All degrees of edema, from slight puffiness under the eyes to general anasarca, were encountered. No patient failed to show it at some time during the illness. It was frequently the earliest sign noted, and was the most common cause of complaint by patients attending the outdoor clinic some months after the subsidence of the acute attack. Evidence of moisture at the bases of the lungs was not inconsistent with complete recovery, but in no case with general anasarca was the renal function restored to normal, and most cases exhibiting this sign ended fatally. No relationship between the plasma

chlorids and the degree of edema present was discernible. The suggestion of some authors that nephritic edema is dependent on acidemia may explain the favorable effects of calcium salts on edema, certainly they did not act by causing diuresis. In cases with troublesome edema, the administration of extra salt or water usually caused the edema to return.

Diuresis.—Normal urinary flow following the liguria was usually established by a steady, but often slow, increase in the urinary output. A number of therapeutic agents were employed from time to time but exerted no well marked diuretic effect. A definite and well marked diuresis occurred in only one case.

Uremia.—Vomiting of a severe and persistent type was the most common clinical manifestation of uremia. This phenomenon might be attributed to acidosis but it was unaccompanied by other manifestations of this condition and was accompanied by definite increase of nitrogenous elements in the blood. Alkali therapy proved of no value. General convulsions occurred in two cases, convulsive twitchings in one case. These three cases ended fatally. The uremia in most instances was asthenic in type. The blood pressure was high following convulsions.

Functional Studies.—The study of renal function furnishes at once the most reliable guide as to treatment and prognosis in nephritis. By this means a truer and earlier estimation of the gravity of the case can be made than by clinical observation alone.

The concentration test is one of the simplest and most reliable of these tests. In no acute case which recovered was there absolute fixation of specific gravity at any stage of the disease, while in other cases, comparable in other respects, its early fixation pointed to the nonresolving nature of the case. More severe functional incapacity, and consequently a worse prognosis, was indicated by fixation at a lower level.

The phenolsulphonephthalein test furnished invaluable information if done after the disease had become quiescent. Excretion of less than 40 per cent. in two hours at this state of the disease was only seen in those cases which tended to chronicity. Values below 25 per cent. were unusual and were found only in severe cases. However, excretion of normal, or nearly normal, amounts does not necessarily indicate a nonprogressive lesion.

The water test did not give such uniformly reliable results as did the concentration test. Very poor response early in the disease was frequently succeeded by normal response a few weeks later. Prognosis based on the excretion of large amounts of water is unreliable. Recurrence of edema followed the test in two cases.

Chlorid excretion furnishes a reliable indication of the progress the patient is making. An initial low chlorid concentration in the urine was present in all cases. No sudden outpouring of chlorids occurred in any case, but in cases tending to recovery the chlorid excretion gradually improved as the outflow of urine did. Traces only were found in some fatal cases. As a rule, the response to the ingestion of additional chlorids corresponded closely with that made to other functional tests, but tended to be worse in cases with much edema.

The estimation of the nonprotein nitrogen of the blood is of value when it is increased, but a normal figure did not always rule out kidney involvement. The urea nitrogen showed a proportionate increase in all cases. Creatinin values of more than "3" indicated severe damage, while those of "5," or over, warranted a fatal prognosis.

SUMMARY

1. The most common etiologic factor in nephritis is an acute infection.

2. Cases of nephritis in childhood may be divided into the following classes: (a) Acute glomerulonephritis, (1) resolving, (2) nonresolving; (b) chronic glomerulonephritis; (c) nephrosis.

The acute cases which recover are differentiated from the nonresolving type, by: (a) better response to renal function tests; (b) steady and rapid improvement clinically, and (c) rapid diminution and complete disappearance of the albuminuria.

The chronic cases differ in the history of past symptoms and signs attributable to the kidney, especially nycturia, in the presence of more numerous casts in the sediment.

3. Relapses occur frequently in the more severe cases, and of themselves justify a bad prognosis.

4. Tests of renal function give invaluable aid in determining the prognosis and line of treatment. The concentration test and the determination of the blood nitrogen constituents furnish the most reliable data.

5. Consideration of the response to functional tests coupled with clinical observation, enables one to foretell fairly accurately the outcome in individual cases.

6. Administration of calcium salts, particularly the lactate, is of definite value in clearing up the edema.

7. Pathologically, the most common lesion in the acute cases is a glomerulonephritis of the intracapillary type, accompanied by more or less degeneration in the cells of the convoluted tubules. The chronic cases showed the same lesions as the acute cases plus scarring and fibrotic changes. In the nephrotic case, tubular changes predominated.

ECZEMA IN BREAST FED INFANTS AS A RESULT OF SENSITIZATION TO FOODS IN THE MOTHER'S DIETARY *

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Eczema in breast fed babies has been even more puzzling to physicians than that occurring in the artificially fed, or in adults. Its etiology has been almost wholly a mystery; treatment has been empirical, and results have been as unsatisfactory as one would expect. Recent researches give promise of a rational explanation of the cause and a scientific method for the cure of the condition. It has been shown that breast milk may transmit foreign proteins derived from the foods of the mother and it is contended that these proteins are responsible for eczema in at least a large percentage of breast fed babies.[1] It is the purpose of this paper to offer further clinical support for this contention.

Since Czerney's work on exudative diathesis appeared his idea of disturbed fat metabolism as a cause of eczema in breast fed babies has dominated opinion largely.[2] Finklestein's "salt" theory gained little support.[3] However, in eczema in artificially fed and older children opinion has diverged widely. Unquestionable cases have occurred in which thyroid deficiency has been a factor, and this has led to the formulation of theories based on disturbance of internal secretory mechanism as a cause.[4] External irritation is considered as a factor by all. It is contended by some clinicians to be the main responsible cause.[5] A disturbed vegetative nervous system has been offered as a cause in some cases.[6] Indeed, Czerny recognized the frequent association of eczema with a disturbed nervous mechanism and attributed to some extent the degree of the condition to this complicating factor. Finally, the discovery of food anaphylaxis and the rapidly spreading understanding of its significance has led to frequent proof of its rôle in the causation of symptoms.[7]

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1. Shannon: Am. J. Dis. Child. **22**:223 (Sept.) 1921.
2. Czerny, A.: Jahrb. f. Kinderh. **61**:199, 1905; ibid. **70**:529; Monatschr. f. Kinderh. **4**:1, 1905; ibid. **6**:1, 1907; ibid. **7**:1, 1908.
3. Finkelstein: Med. Klin., 1907 (Quoted from Gerstenberger).
4. Edelman, M. H.: Med. Rec. **91**:303, 1917.
5. Simpson; J. A. M. A. **58**:995 (April 6) 1912.
6. Hazen: Arch. Dermat. & Syph. **1**:642 (June) 1920.
7. Blackfan: Am. J. Dis. Child. **11**:441 (June) 1916. Talbot: Boston M. & S. J. **179**:285, 1918; ibid. **175**:409, 1916. Fox and Fisher: J. A. M. A. **75**: 907 (Oct. 2) 1920. White: Boston M. & S. J. **178**:5 (Jan. 3) 1918.

O'Keefe opened the way for a rational understanding of eczema in breast fed infants.[8] He showed that "a large percentage of breast fed infants suffering from eczema show a positive cutaneous reaction to food proteins" and suggests that "foreign proteins occurring in the breast milk are the most probable means of such sensitization in this group of cases." He found that about 40 per cent. of these patients were cured by omission from the diet of the mother of the articles of food to which the infant was susceptible and that 20 per cent. more were definitely benefited.

Following on the work of O'Keefe, Shannon [1] demonstrated the presence of egg and veal protein in breast milk after their ingestion by nursing mothers.[9] Strong clinical evidence was presented that the same might be true of almost any food that the mother might eat. Cases showing various exudative phenomena were presented and shown to be due to the presence of various proteins to which the infants were sensitive in the breast milk.

Aside from the papers referred to there is little mention in the literature of food anaphylaxis as a cause of eczema in breast fed babies. Talbot mentioned a case in which chocolate in the diet of the mother seemed to have been responsible for a severe eczema in an infant.[10] Schloss mentions sensitivity to egg in artificially fed children who had never received egg in their diet.[11] They developed symptoms when fed egg protein. Occasionally, mention is made of the fact that the infant may be upset by certain foods that the mother may eat, but no mention is made of such foods being responsible for eczema.[12] Neither is the suggestion made that the protein of such food is the responsible factor.

Naturally, with ideas as to the etiology of eczema in breast fed infants so poorly formulated, treatment has not been satisfactory. For the most part it has been directed at the external factor, in itself not understood. What has been done in the way of internal therapy has been confined to the regulation of feeding with a view to cutting down the fat intake, as originally done by Czerny, or to the bolstering up of some imaginary incompetent mechanism of internal secretion.

The cases of eczema here reported occurred in either exclusively or essentially breast fed infants. Treatment was mainly dietary. Recourse

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8. O'Keefe: Boston M. & S. J. **183**:569 (Nov. 11) 1921; ibid. **185**:194 (Aug. 18) 1921.
9. Shannon: Minnesota Med. **5**:137 (March) 1922.
10. Talbot: M. Clinics N. America, January, 1918, p. 985.
11. Schloss: Am. J. Dis. Child. **19**:433 (June) 1920.
12. Mulherin: J. A. M. A. **75**:855 (Sept. 25) 1920 (Discussion by Dr. Charles J. Bloom). Westcott: Am. J. Obst. **78**:55. Rotch: Pediatrics, 1901, p. 137. Griffith: Diseases of Infants and Children **1**:105, 1919. Colburn: Nebraska State M. J. **4**:243 (Aug.) 1919.

was had to external applications as a supplementary treatment in most cases. Several cases had shown no improvement during a preliminary period of external therapy alone.

Dietary treatment consisted in the removal of offending foods from the dietary of the mother and patient or their limitation. It was guided by the results of cutaneous protein tests performed on the infants. The technic of the tests was that described by Walker,[13] with the exception that the infant's back was used instead of the forearm. Interpretation of the positive reaction was based on the occurrence of an erythema at the site of the test, as well as a wheal, as stated at a previous time.[9]

REPORT OF CASES

CASE 1.—Baby boy, 7½ months old, had eczema since 2 months of age. A reddened scaly eruption was present over the scalp, forehead and cheeks; marked papular eruption over left forearm and wrist, and to a smaller degree, over the right forearm and wrist.

Application of Lassar's paste for four days caused no improvement. Patient was tested with carrots, lima beans, lactalbumin, orange, cocoa, salmon, potato, navy bean, tomato, egg white, casein, wheat, pea, egg yolk, mackerel, rice, human milk, banana and pork, foods which were common in the diet of the mother, or which the infant had eaten. The infant had had cream of wheat, soda crackers, cow's milk and carrots. Positive reactions were obtained to carrots, lima bean, beef, banana, salmon, potato and pork, and questionable reactions to mackerel, rice, egg white and yolk.

External treatment was continued as before, and the mother was instructed to give the baby no more carrots and to eliminate from her own diet all pork, carrots, salmon, mackerel and banana. She was told to eat beef, egg, lima beans and rice no more than twice weekly, and to limit potato to one heaping tablespoonful daily.

Nine days later the hands and forearms were well. The scalp and right cheek were much improved but an impetigo had developed on the left cheek. This spread over the entire scalp and by the time this was cleared up, one month after the diet had been instituted, the eczema had disappeared, except for a slight scaliness over the left cheek and the forehead.

Two weeks later the patient returned. The mother said that until two days previously the skin had been perfectly smooth. At this time, concomitant with the cutting of two teeth, the rash had appeared on the scalp and the cheeks. Protein tests revealed positive reactions to spinach, which had not been tested before, and wheat, which had previously been negative. The infant had been receiving both these foods in his diet since the previous visit. Removal of these foods from the mother's and the patient's diets caused marked improvement in one week and disappearance of the eczema in one month. Since that time the baby has been weaned and is eating all of the foods to which he was sensitive, except carrots, lima beans and egg. The mother says that for a time slight palpable roughness would come and go on the cheeks. When last seen, six months after the first visit, there was no trace of eczema, although several teeth had erupted. The baby had been weaned and was doing nicely.

CASE 2.—Baby girl, 4 months old, was breast fed entirely, except for barley water. Eczema had been present since 6 weeks of age. When seen, a scaling eczema was present on the cheeks, chin, forehead, ears, neck, scalp and on the backs of the hands. The face was very red and angry looking, although there was no weeping or vesiculation. Over the back of the head the lesion was papular.

13. Walker: Oxford Med. **2**:122.

The infant had already been on local treatment for two weeks, with continued progression of the eczema. Cutaneous tests were made with the following food proteins—tomato, pork, grapefruit, chicken, egg white and yolk, veal, asparagus, barley, orange, oats, beef, wheat, rice, corn, casein, spinach, potato, peas, rye, banana and carrots. Positive reactions were obtained to egg white and yolk, rice, corn, potato, rye and carrots. Egg white gave both erythema and wheal. The remainder were only erythemas.

The mother was instructed to eat no eggs or food containing eggs, rye, or corn; to limit potato to two tablespoonfuls daily, and to limit carrots and rice to two tablespoonfuls twice weekly. Veal was to be eaten no more than once weekly. Lassar's paste was prescribed for the face and a mild scaling ointment for the scalp.

Very marked improvement had occurred in two weeks, which steadily continued with mild periods of exacerbation, until all signs of eczema disappeared five weeks after institution of treatment. One month later a slight scaliness was present on the cheeks which, the mother said, would come and go. At this time solid foods were added to the infant's diet. The mother did not return for a period of six months, during which time the infant had had no skin lesions of any kind. Within this period several teeth had erupted. The mother had completed the weaning and had come to restrict no foods but eggs. The mother herself had ceased her own dietary restrictions three months after the institution of treatment and no recurrence of symptoms had occurred in the infant.

CASE 3.—Baby girl, 5½ weeks old, was breast fed entirely. There had been no rash present on the skin until she was two weeks of age. At that time eczema had developed and it spread rapidly. The development of this condition was accompanied by considerable colic. When seen the infant had been on local treatment for one week with no effect on the course of the eczema. A very angry looking weeping and crusting eczema was present over the entire face and scalp and over the ears. Intertrigo was present in the folds of the neck. The skin over the buttocks was very irritated. The skin over the body was rough and reddened.

On questioning, the mother was found to be eating from two to five eggs daily. A sample of breast milk was obtained and egg protein was demonstrated to be present.[1] The mother was told to omit all eggs or foods containing eggs from her diet. Lassar's paste was prescribed for the face. Eleven days later the mother reported that the condition was entirely clear, except for a little breaking out on the cheeks and slight crusting on the scalp.

Sixteen days later she returned with the story that two days previously the infant's face had begun to break out. When seen there was a papulovesicular eruption over the upper part of the face and forehead. The anterior part of the scalp showed a scaly eruption. At this time the infant was tested with lamb, oat, tomato, carrot, veal, egg white, grapefruit, peach, beef, egg yolk, casein, cauliflower, chicken, pork, barley, wheat globulin, lactalbumin, wheat gliadin, cocoa, wheat leucosin, beet, pea, rye, potato, cabbage, rice, banana, corn, human milk and celery. Erythematous reactions were obtained to veal, egg white and yolk, grapefruit, beef, chicken, barley, wheat leucosin, pea, rye, potato, banana, corn and celery. A questionable reaction was obtained to rice.

The mother was instructed to eat no egg or food containing egg, grapefruit, pork, pea, celery, banana, barley, or chicken; to eat beef, veal, wheat cereal, or rye cereal no more than twice weekly; to eat rye bread, and to eat sparingly of all wheat-containing foods.

Four days later there was considerable improvement of the eczema. However, the cheeks were still red at times and the forehead was rough and scaly, although not red. At this time I noticed that I had not restricted potato and the mother had been eating a great deal of this food. She was, therefore, told to eat no more than two tablespoonfuls three times a week.

Since this time there have been occasional appearances of rash on the cheeks in the form of what the mother calls "a few pimples," but most of the time the eczema has been absent entirely.

CASE 4. — Baby girl, 8 weeks old, was entirely breast fed. Eczema had appeared about three weeks previous. When seen a reddened, scaly eruption was present over the face, forehead and scalp. The skin over the back was roughened and scaly. Tests were made with coffee, beef, casein, individual wheat proteins, egg white and yolk, cabbage, oyster, human milk, grapefruit, tomato, pork, lactalbumin, rice, beet, salmon, potato, carrot, pear, orange, chicken, whole egg, oat, cauliflower, banana, veal, cucumber, pea, squash, strawberry, lettuce, cocoa and rye. Erythematous reactions were obtained to coffee, beef, wheat leucosin, pork, lactalbumin, salmon, rice, egg, potato, oat, pea, wheat proteose, cucumber and strawberry. The following restrictions were placed on the mother's diet: no coffee, beef, eggs, pea, salmon, cucumbers, wheat cereal, or white bread; no pork, except bacon or ham, and these infrequently; potato no oftener than four times a week; and rice, oranges, oats and strawberries no more than three times a week. Boil all milk and skim off the coagulum. Everything not mentioned could be eaten in unlimited quantity.

Two and one-half weeks later the mother reported that all skin lesions had disappeared, except a slight scaliness of the scalp. No local applications were used.

Eight days later the mother reported that the eczema had cleared up entirely at one time but that a few days previously the eruption had again appeared on the face. On close questioning she admitted that she had begun to eat some foods containing egg, and that she had begun to drink coffee. She was again cautioned not to eat these foods and nothing more was done. One month later the mother reported that all trace of eczema had disappeared promptly following the resumption of her diet, and that ever since the skin had been perfectly clear.

CASE 5. — Baby boy, 4 months and 1 week old, was breast fed entirely, except for orange juice and barley water. Eczema had appeared at 6 weeks of age, first on the scalp, and had spread later. When first seen there was a weeping and crusting eczema over the scalp and an angry looking scaly eruption over the face, neck and anterior surface of the trunk. The skin of the arms and legs was indurated and scaly. The infant had been under the care of a pediatrician for some time, in spite of which the eczema had spread. The infant was tested with corn, celery, egg yolk, rice, milk, carrot, wheat, tomato, peas, grapefruit, beef, casein, veal, barley, egg white, pear, asparagus, chicken, strawberry, cabbage, banana, oat, salmon, human milk, potato and pork.

Erythematous reactions were obtained to corn, egg white and yolk, grapefruit, milk and veal. Questionable reactions were obtained to chicken, wheat and cabbage. Two days later the egg yolk and grapefruit reactions were red, indurated and scaly.

The mother was taken off the foods to which the baby reacted. Improvement was very rapid for a period of five or six days, the mother said, when the infant developed a cervical adenitis and the eczema got worse. However, it did not revert to a condition as severe as when first seen. The abscess was opened and drained. The eczema remained stationary for a period of about two weeks, when the skin condition suddenly got much worse. The mother was instructed to pin the baby down on a hard bed and cover the body with Lassar's paste. This she did, and one week later the skin showed much improvement. On the day before this visit the mother said that a discharge was coming from one ear. From this point on improvement was steady. Further tests were done and positive reactions were obtained to beef, tomato, rice, rye and barley. These foods were restricted from the diet of the mother. Cod liver oil was added to the mother's diet. When last seen, twenty-five days after the ear had begun to drain, which was the last of a series of complications following a very severe nasopharyngitis, there was a slight roughness over the scalp and face. The skin over the anterior surface of the trunk was clear and the leathery condition of the skin of the arms and legs had largely disappeared.

CASE 6.—Baby girl, 4 months old, was breast fed. Eczema had appeared at 1 month of age and had become steadily worse. When seen there was a severe weeping eczema of both cheeks, papular eruption over the scalp, and scaly lesion on the chin.

Tested with egg yolk, barley, wheat, casein, cocoa, grapefruit, lactalbumin, corn, rice, veal, asparagus, strawberry, potato, chicken, banana, carrot, oat, pea, human milk and egg white. Positive erythematous reactions were obtained to egg yolk, casein, grapefruit, lactalbumin, strawberry, carrot, egg white, corn, rice, veal, asparagus, chicken and peas. Potato was doubtful. The mother had noticed that the baby had colic when she ate grapefruit.

Lassar's paste was prescribed for the face and the following restrictions were placed on the mother's diet: Eat no grapefruit, eggs, strawberries, veal or asparagus. Eat carrots, corn, rice and peas no more than twice weekly. Eat no more than two tablespoonfuls of potato daily. Eat infrequently of chicken. Take no more than one pint of milk daily and boil this for three minutes.

The baby developed mumps two days later, and the eczema spread over the body and arms. The back developed indurated and scaly patches around several of the positive tests. During the course of the mumps the eczema did not improve. As soon as the infant was well of the mumps she was put in the hospital where greater detail could be given to local treatment and control of scratching. Here the infant was placed on a hard bed with hands tied down and Lassar's paste applied to the entire body. In eleven days the child was discharged from the hospital very much improved. Five days later all that remained of the skin lesions was a slight seborrhea, a few papules on the neck, and some roughness of the cheeks. One week later a slight roughness of the cheeks only was present. Since that time an occasional roughness has appeared on one or both cheeks, but most of the time the skin is as clear as any baby's. At 10 months of age the baby was entirely weaned and is now, at the age of 1 year, taking all of the food that an ordinary baby of this age is given, with the one exception that all milk is boiled five minutes.

It is in the unfavorable case that theories are most rigidly tested. I therefore present the following cases which I should consider unfavorable, in order to analyze them from the standpoint of anaphylactic cause.

CASE 7.—Baby girl, 4 months old, was entirely breast fed. Eczema had appeared at 2 months and gradually spread so that when first seen there was a scaly, slightly crusted, angry looking eruption over the cheeks and scalp. A papular eruption was present over the diaper region, the outer aspect of the left leg, and in the left anticubital space. Blepharitis of both lids was present.

Cutaneous tests were made to coffee, pork, oats, salmon, egg white, rice, carrot, casein, cabbage, lactalbumin, peas, yolk, potato, human milk, wool, beef, veal, banana, wheat and orange. Erythematous reactions were obtained to beef, wheat, carrots, potato and banana. Egg white and casein gave both an erythema and a wheal. Orange and veal were regarded as questionable.

The mother was told to eat no egg or food containing egg. No more milk was to be taken than was necessary on cereal, etc., and this was to be boiled for three minutes.

The mother did not return with the patient for six weeks, during which time the eczema had improved greatly. There had remained, however, a slight scaliness of the cheek, a seborrhea of the scalp and some eczema on the arm. Two weeks before the second visit the eczema had begun to get worse, and when seen the infant was much worse than on the first visit.

The mother was instructed to continue the first restrictions and, further, to eat no beef, veal or banana. No wheat containing foods were to be taken except rye bread. Potato was to be eaten only three times weekly. Oatmeal was prescribed for the baby.

One week later there was marked improvement but there was still crusting on the cheeks. Two teeth had erupted.

The infant was then tested with human milk, rye, barley, wheat, peas, egg yolk, whole egg, lactalbumin, cabbage, oat, orange, veal, milk, rice, salmon and beef. Many of these had previously been negative, others positive or questionable, and still other foods were new. Whole egg and egg yolk gave both erythema and wheals. Milk and beef both gave an erythema. Veal, which had previously been questionable, remained the same. Wheat had been previously positive but was negative now.

The mother admitted that she had been eating white bread and store cake, which contained some egg. She was further instructed to eat no egg or food containing egg, no beef, and to drink as little milk as possible. She was permitted to eat a small amount of wheat bread, since she insisted that she could not eat rye bread.

Three weeks later the mother returned with the baby. There had been marked improvement in the eczema. However, she insisted that the baby had not been getting enough breast milk and that, therefore, she had begun feeding a complementary milk mixture and cream of wheat a few days before.

Because it seemed impossible to have the cooperation of the mother it was decided to allow her to continue the feeding of these foods to which the infant gave positive skin tests as an experimental procedure. Two weeks later the mother returned with the patient showing a marked exacerbation.

Cutaneous reactions were again repeated, with whole egg, banana, veal, lactalbumin, casein, potato, wheat globulin, beef, milk, carrot, wheat, wheat leucosin, proteose, gliadin, glutenin, salmon and egg yolk. Positive reactions were obtained to egg yolk, whole egg, banana, potato, wheat, wheat leucosin, carrots, veal and beef. Questionable reactions were obtained to several more of the individual wheat proteins. The mother admitted that she had of late begun to eat egg, banana, wheat, potato, beef and veal.

The mother was once again given instructions to eat no egg, banana, carrots, veal, or beef; to drink as little milk as possible; to eat potato only three times a week. The baby was to have oat, rye, barley or rice cereal instead of wheat, and to continue the milk mixture well boiled. Spinach and carrots were to be added at the 2 o'clock feeding.

Two months later the mother returned with the patient. During this time the eczema had been practically absent until one week previously. At this time a marked exacerbation occurred. This came with the cutting of two teeth and a bad head cold complicated by a double otitis media.

On close questioning the mother admitted that she had adhered to the diet for awhile but that of late she had restricted neither her own nor the infant's diet to the foods prescribed. I again cautioned the mother regarding the diets of herself and the baby and dismissed her.

In this case treatment was discontinued after a period of five months, with the eczema in just as bad shape as it was when treatment was started. During this entire time the patient was seen only six times. Three exacerbations occurred. At the time of each flare-up the mother admitted that a short while previously she had ceased to follow the dietary instructions given, and that she was either eating or feeding the baby the forbidden foods. After each visit there was a period of marked improvement, during which time the diet was adhered to, amounting to practically complete cure, according to the testimony of the mother. Two of the recurrences occurred at times of teething, when it is well known that eczema is likely to become worse. It is interesting to compare this point with Cases 1, 2 and 6, in all of which teething occurred without new outbreaks of the eczema after treatment

had been instituted. It is reasonable to assume that a strict adherence to the dietary regime laid down would have prevented the recurrences in this case as well.

The following unfavorable case is of interest from another point of view:

CASE 8.—Baby girl, 8½ months old; eczema had begun at the age of 2 weeks. The infant had been under the constant care of a pediatrician since that time, with no favorable effect on the eczema. The mother came in for advice as regards weaning, believing, as she had been told, that eczema was incurable and nothing could be done. Lately she had been giving a little cow's milk and had noticed that wherever this came in contact with the skin of the face around the mouth large welts appeared. Besides breast milk the infant had received cow's milk, carrots, spinach and cream of wheat.

When first seen there was a very angry looking, crusted eruption over the face, the forehead and the diaper region. The mother stated that at times it had been present over practically the entire body, but that just now it was improved.

Cutaneous tests were made for orange, lamb, asparagus, chicken, strawberry, celery, pear, spinach, wheat gliadin, cocoa, beef, wheat proteose, wheat glutenin, rice, cow's milk, carrots, navy bean, cucumber, wheat globulin, egg yolk, tomato, veal, whole egg, barley, cauliflower, human milk, lettuce, cantaloupe, wheat leucosin, cabbage, grapefruit, salmon, rye and oats. Positive reactions consisting of both an erythema and a wheal were obtained to wheat, wheat gliadin, wheat glutenin, wheat proteose, cocoa, rice, cow's milk, wheat globulin, egg yolk, whole egg, barley and wheat leucosin. Erythematous reactions were obtained to orange, lamb, chicken, celery, pear, beef, pea, salmon, cantaloupe, lettuce and veal. The controls were negative. There were thus only twelve out of the thirty-five proteins tried that were negative.

The following dietary restrictions were imposed on the mother: to eat no wheat cereal, rice, barley, tomato, celery, chicken, beef, salmon, pears, cantaloupe, cocoa, or chocolate. Asparagus, peas, beans, lettuce, potato, corn, veal and pork were to be eaten no more than once or twice weekly. Milk was to be taken only on cereal and this was to be boiled five minutes. Rye bread or rye crisp were to be eaten in place of wheat bread, although this contained 50 per cent. wheat flour.

The baby was to be given rye or oat cereal at the 10 a. m. and 6 p. m. feedings, and either spinach, carrots, or cauliflower at 2 p. m.

Lassar's paste was prescribed for local treatment. With this the mother was perfectly familiar.

Two weeks later the mother said there had been a marked improvement. Broths were then prescribed for the baby and the condition immediately got worse.

The infant was seen the second time, one month after the diet had been prescribed. At that time the cheeks were better than at the first visit, but much worse, the mother said, than they had been before broths were given to the baby. The skin over the diaper region was very much improved.

The diet of the mother was not changed. That of the baby was modified as follows: asparagus, peas, string beans, cauliflower and carrots were to be given, each in small quantity and not more than twice weekly at the 2 p. m. feeding, with rye and oat cereal as before. Lamb broth only was to be given, and that at the 2 p. m. feeding. Apple sauce and potato were to be added at 2 p. m. Nursing was to be discontinued at this hour. The attempt to get goat's milk was unsuccessful.

Sixteen days later there was some improvement in the eczema over the face. However, the cheeks were still rough and slightly red, while the buttocks had isolated spots of erythema. Instructions were given to add rye bread toast at 2 o'clock, and 3 ounces of milk boiled five minutes before the 10 a. m. and 6 p. m. feedings.

One week later the skin over the buttocks was normal. The cheeks were still rough and slightly reddened. The infant's diet was so altered that she should be nursed only at 6 a. m. and at 10 p. m. Three ounces of milk boiled five minutes were to be given at 10 a. m. No new vegetables, cereals, broths, or fruits were added, although the quantity was increased.

One month later the mother reported that the baby was much better. She was taking 4 ounces of the boiled milk, three times daily. The eczema had improved greatly and all evidence of the cold which the infant had had constantly since birth was gone.

Ten days later the skin of the face, legs and arms was still slightly roughened but not reddened. The infant was entirely weaned from the breast. The mother was instructed to give 4 ounces of boiled milk twice daily as a beverage, and to cook the cereal in milk. Cod liver oil was added in the form of 1 teaspoonful of the emulsion three times daily.

Four days later the mother returned with the story that the eczema had broken out afresh and that it was about as bad as it had been at the first visit. She was told to discontinue the cod liver oil and no further change was made. At the present time, five weeks after the cod liver oil was discontinued, the eczema is but slightly improved.

In this case also the eczema was almost as bad at the end of four months of treatment as it was in the beginning. However, such a result was anticipated on the first day. The infant was sensitive to the main articles of the mother's diet and should be weaned. In spite of the widespread sensitization, the anaphylactic property of the breast milk seemed to be decreased by limitation of the mother's diet sufficiently for marked improvement to occur so long as the infant was receiving only foods to which no reaction was obtained. When, however, beef, mutton and chicken broths were added to the diet of the infant, an immediate exacerbation resulted. Erythematous reactions had been obtained to all of these foods. Careful selection of foods permitted a gradual improvement of the eczema to progress along with the weaning process. However, when the infant was finally taken entirely from the breast, a severe recurrence resulted. The addition of the cod liver oil at this particular time was unfortunate. It may have been responsible indirectly for the outbreak. On the other hand, the recurrence might have occurred had the cod liver oil not been given. At any rate, its effect could only have been indirect since recovery was not prompt after its removal from the diet. Just before this outbreak the cow's milk in the infant's diet was increased. It is more probable that this increase overstepped the patient's tolerance for cow's milk and that, as a result of this mistake, the eczema recurred.

Eight cases of eczema in breast fed babies have been reported in detail. In all cases the main consideration in the study and treatment has been the anaphylactic reactions of the infant to foods contained in the mother's dietary. These reactions have been determined by the use of cutaneous tests done on the infants with the proteins derived from the foods that the mother has been eating. The interpretation of the positive reaction has been based on the occurrence of an erythema

at the site of the test, as well as a wheal. This is insufficiently emphasized by the majority of other observers in this field, and is very important. By far the majority of subjects give only erythematous reactions to the cutaneous tests, and if this type of reaction is not recognized in its full importance, results are bound not to be satisfactory. Of the cases cited four only gave a wheal in any reaction. Of these four cases, three gave a wheal to only one of the foods tested. The other case, having been a very severe one, gave a wheal at the site of the test with twelve different proteins. In Cases 1, 3, 4 and 7 return of the eczema can be traced quite definitely to the eating of foods to which an erythematous reaction only was obtained. Furthermore, some of the erythematous reactions in Cases 1, 5 and 6 remained for a period of from twenty-four to forty-eight hours, giving rise to scaly, eczematous patches before they disappeared.

Local treatment was used in almost all of the cases cited and consisted of the application of Lassar's paste to the affected areas whenever used. In several cases local measures had been employed for varying periods of time, without result before dietary measures were begun. In several of the cases in which exacerbations occurred the mothers had employed this treatment as soon as the rash had appeared and the local treatment had failed to check the progress of the eczema. On the other hand, it seemed to be of some value in combination with dietary treatment in minimizing external factors and thereby hastening cure.

Dietary treatment consisted in the removal of the offending foods or their limitation in the diet of the mother and patient. Certain foods, as eggs, were always eliminated. However, very frequently sensitization was so widespread that all foods could not be eliminated. In these cases the foods which gave the strongest reactions were eliminated so far as possible and the others were limited both as to quantity and the frequency with which they were eaten. It was thus very often impossible to remove entirely all of the offending foods from the diet of the mother. Particularly is this true when wheat is an offending food.

Sensitization in all of the cases tested was multiple. In one of the unfavorable cases no less than twenty-three different proteins gave definite reactions. In this fact is to be found the obstinacy of the disease. There are cases, however, in which a smaller number of foods is causative. The cases cited by O'Keefe,[8] in which relief was obtained by the removal of one or two foods from the diet of the mother, are apparently of this type. It is not improbable that only a few of the foods to which an infant reacts are causative at any one time, and that, had we a method of determining which of the group these were, cure might be obtained by a less complete limitation of the diet of the

mother. However, for the present, it seems advisable to consider all foods giving a positive reaction in the infant as contributing factors, and to eliminate them from, or limit them in the diet of the mother.

Sensitization may occur to new foods throughout the course of eczema. This may give rise to new exacerbations of the disease. Flare-ups of this kind do not in any way weaken the theory, but rather strengthen it. If, on a new outbreak of the disease, we are able to demonstrate a newly acquired sensitization, and are able again to cause a disappearance of the symptoms by removal of these foods from the mother's diet, it would seem more certain than ever that foods were responsible. Such a phenomenon occurred in Cases 1 and 5. This observation brings up an important point in the management of these cases. The mother should be cautioned to eat a large variety of foods and a small quantity of individual foods. It seems that this would militate against further sensitization and is advisable as regards foods to which the infant is not sensitive, as well as those to which a reaction has been obtained but which could not all be eliminated from the diet.

Failures will continue to occur in this method of treatment as in any other. These may be explained in any one of several ways. First, it is essential to have the complete cooperation of the mother. Case 7 is an outstanding example of failure to effect a permanent cure on account of the lack of such cooperation. In this case almost every return of the eczema was occasioned by the fact that the mother had ceased to live up to the requirements of the diet prescribed. Each time she returned and was again encouraged improvement resulted until she again gave up to her appetite, when the disease once more broke out in the infant. In Case 4 the return is explained in the same way. Second, sensitization may be so widespread that it is impossible to prescribe a sufficiently liberal diet to mother or patient without utilizing some of the offending foods. Case 8 was such a case. Even in this case improvement occurred up to the point where it seemed necessary to add the offending foods to the diet of the infant. Third, failure on the part of the physician to test with all the foods may result in failure to effect a cure because of the fact that all of the offending foods may not have been eliminated. Case 1 illustrates this point. Spinach was not tested at the first visit because the mother did not eat it. It was prescribed for the baby and when, six weeks later, an exacerbation occurred, the infant was found to be sensitive to this food. O'Keefe would unquestionably have obtained a larger percentage of cures had he tested with a larger variety of foods and limited the mother's diet accordingly. Fourth, sensitization to new foods may occur and prolong the disease, as in Cases 1 and 5. Fifth, failure may occur as a result of unavoidable sources of error in the skin tests. Difference in technic

and interpretation will undoubtedly account for many of these errors. However, given a uniform technic and an identical interpretation, errors are bound to occur. Walker has shown that negative skin tests may be obtained to foods to which an individual is sensitive if the individual has not been eating that food for some time.[13] Schloss has shown that after a severe outbreak of urticaria following the ingestion of an offending food the skin test may disappear for a period of a few weeks.[11] An example of this latter type of reaction occurred in Case 7. On the first test the infant was sensitive to wheat. Following an exacerbation of the eczema, preceding which the mother had been eating cake and white bread, the reaction to wheat was negative. Tested again several weeks later the reaction to wheat was again positive.

Czerny [2] and others have called attention to the fact that intercurrent disease is prone to have an unfavorable effect on the course of an eczema. He even advises against vaccination in these cases for this reason. Intercurrent disease giving rise to general manifestations occurred in two of these cases. It is of interest that these two were the most resistant of the favorable cases. Case 5 improved remarkably for a period of six days after the mother had been instructed as to her diet, when a severe nasopharyngitis, complicated by a cervical adenitis, developed. The eczema immediately reverted to somewhat of its former condition, although to a lesser degree. The adenitis was followed by an otitis media and definite improvement of the eczema did not again occur until after the ear had begun to drain. From that point on improvement was rapid for a period of twenty-five days, after which the patient did not return. Case 6 developed mumps two days after institution of treatment and the eczema spread over the entire body. On recovery from the mumps the patient was placed in the hospital in order to give attention to local treatment, and because the parents, not understanding the effect of the general condition on the eczema, were becoming impatient. From this point on improvement progressed rapidly to permanent cure. Had it been possible to eliminate all of the offending foods from the dietary of the mothers in these cases, we should expect not to have observed these severe exacerbations. However, this was not possible because of the widespread sensitization. Furthermore, Case 5 had become sensitive to several new foods in the interval.

The effect of teething on the recurrence of eczema is well known. Case 1 shows this point well. A repetition of the protein tests showed sensitization to two foods that the infant and mother were eating. Sensitization to one of these foods had occurred since the previous tests were made. The other had not been tested. Removal of these foods from the mother's and patient's diets caused prompt disappear-

ance of the symptoms. Since that time there has been no recurrence of the eczema in this patient at times of teething. Cases 2 and 6 also have had no recurrence of their eczema at times of teething.

A point of considerable practical importance arises in the question: when is it safe for the mother to resume her general diet, and when is it going to be possible for the infant to take the foods to which he has been sensitive after he has been weaned? Several of these cases have been followed long enough to throw some light on these questions. In Case 1 potato was added to the infant's diet two and one-half months after the mother had been restricted, without return of the eczema. Six months after the diet of the mother was instituted the infant was placed on a general diet for a child of its age, except that lima beans, carrots and eggs were withheld. There has been no recurrence of the eczema. In Case 2 the mother ceased her own dietary restrictions about three months after the diet was instituted, without recurrence of the eczema in the baby. One month later potato was added to the diet of the infant without bad results. In Case 6 the child was allowed to eat the foods to which she had been sensitive four months after the diet had been imposed on the mother. In Case 4 the eczema recurred when the mother resumed eating restricted foods one month after the restrictions were imposed. From these few cases it would seem that it might be possible for the mother to begin resuming her general diet after about three months, and that after a period of from four to six months it is safe for the infants to take the foods to which they have been sensitive. I feel certain that the result in Case 8 would not have been unfavorable if I had held off on weaning for a sufficient time, adding to the baby's diet only those foods to which she had shown no reaction and permitting her to receive her necessary quota of milk from the mother.

A study of this kind cannot but force on one a consideration of what might be done to prevent this malady. From what has been said it is seen that the nursing mother should be cautioned to eat a large variety of foods and a small quantity of individual articles of diet. Eggs, because of their frequent concern in this disturbance, should not be forced but rather restricted. Unquestionably some persons acquire their sensitization for some foods before birth, but in the majority this sensitization is acquired after birth through the breast milk. There is every reason to believe that in infantile eczema, as in protein sensitization in older children and adults, sensitization becomes more widespread as time goes on. It therefore behooves us to study these cases early and to try to eliminate the offending foods before sensitization has become so universal as to make their limitation a hardship, or even an impossibility. It seems reasonable that it might hinder further

sensitization, in view of the frequent intestinal upsets in these cases, which Schloss has shown predispose to absorption of undigested protein.[14]

CONCLUSIONS

The foregoing study permits of the following conclusions:

1. Eczema in breast fed babies is a result of sensitization to food proteins contained in the mother's dietary and transmitted to the infant throught the breast milk in at least a great majority of cases.

2. Removal of these proteins from the diet of the mother usually results in cure of the condition in the patient.

3. In cases in which all the foods cannot be eliminated from the diet of the mother, limitation of the same will often result in improvement of the eczema, presumably because there is a threshold in the mother up to which the food may be eaten without appearing in the breast milk.

4. Sensitization of the infant may be determined by the cutaneous reaction to the purified food proteins.

5. The erythematous reaction at the site of the test is to be considered as indicating sensitization, and being much more common than the wheal, is correspondingly more important.

6. Sensitization is usually multiple and may be to a majority of the foods in the dietary of the mother.

7. Sensitization tends to become more widespread in a great many cases as time goes on, due to the acquisition of sensitization to new foods.

8. Repeated exacerbations and failures to cure may be due to (*a*) a lack of cooperation on the part of the mother; (*b*) sensitization so widespread as to make sufficient limitation of diet impossible; (*c*) failure on the part of the physician to test for all of the foods; (*d*) the acquisition on the part of the infant of sensitization to new foods, and (*e*) errors in the procedure of determining sensitization whether avoidable or otherwise.

9. As general prophylactic measures it is recommended that all mothers be cautioned to eat a large variety of foods and a small quantity of any individual article of diet, that eggs be restricted rather than forced in the diet of the mother, and that all cases of eczema be studied early and offending foods eliminated before sensitization becomes so widespread as to make proper limitation of diet impossible.

10. The proper study of all cases of eczema in breast fed babies that do not yield promptly to the older methods of treatment requires the determination of sensitivity in the infant to all of the foods contained in the diet of the mother and, in the event of exacerbations, the frequent repetition of these tests. Until the physician has done this he cannot be considered as having done his whole duty to the patient.

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14. Schloss and Worthen: Am. J. Dis. Child. **11**:342 (May) 1916.

SITTING-HEIGHT AND STEM-LENGTH IN PRIVATE SCHOOL BOYS *

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Reason for Studying These Measurements.—As a gage of build, the hitherto honored standard of stature (standing-height, H) is equaled or excelled by the "essential stature" (the body-trunk, measured by different observers from slightly different landmarks, e. g., sitting-height, Si, or stem-length, λ). Evidence for this statement has been exhibited in recent papers [1] on the relation between these three body-measurements (H, Si, λ) and body-weight.

A new interest, therefore, arises in standards of sitting-height and of stem-length for children at successive ages. For the former (Si) tables already exist, but only (with rare exceptions) for children (1) of mixed nationality, (2) in public schools, and (3) without exclusion of those clinically below par. For stem-length (λ) no tables have been found in the literature.

The motive of this paper accordingly is the offer of tentative standards of sitting-height and especially stem-length for children: (1) of American birth and, indeed, of pure American stock (so far as such a thing can be found); (2) in private schools, i. e., in children of the best-fed and most carefully developed kind, and (3) after rejection of children subnormal to physical examination.

The data presented here, then, are supplementary to the tables (height for age, chest-girth for age, weight for height, and weight for chest-girth) which have been tentatively offered [2] as "Ideal," to distinguish them from the usual averages on mixed material.

New Material.—The subjects studied were 114 pupils at Mr. Robert W. Rivers' Open Air School for Boys, a country day school in Brookline, just outside this city. I am grateful for the opportunity to the principal and also to the school physician, Dr. Richard M. Smith.

From the latter's two recent studies on this establishment,[3] it may be seen that the subjects represent a favored group, of American birth, good breeding in the broadest sense, and careful nurture.

* Received for publication Dec. 10, 1921.

1. Gray, H., and Root, H. F.: Boston M. & S. J. **184**:439 (April 28) 1921; Ibid **185**:28, (July 7) 1921; Gray, H., and Walker, A. M.: Am. J. Physical Anthropology **4**:231 (July-Sept.) 1921; Gray, H., and Edmands, G. H.: Am. J. Dis. Child. **23**: to be published (March) 1922.

2. Gray, H.: M. Clin. N. America **4**:1899 (May) 1921; Gray, H., and Jacomb, W. J.: Am. J. Dis. Child. **22**:259 (Sept.) 1921; Gray, H.: Am. J. Dis. Child. **22**:272 (Sept.) 1921.

3. Smith, R. M.: A Health Study of a Boys' School, Am. J. Dis. Child. **18**:246 (Oct.) 1918; A Twenty-Four Hour Schedule for Schoolboys, Am. J. Dis. Child. **20**:115 (Aug.) 1920.

Furthermore, the subnormal samples of boyhood discoverable in process of betterment in every school have been in this study sifted out by means of the past history as obtained from parents, the physical examination by the school doctor, by irregularity in school attendance, and by general lack of stamina as observed from day to day by the school nurse in constant attendance.

TECHNIC OF MEASUREMENT USED HERE

Standing-Height.—The stature was measured to the nearest half-centimeter, with the subject barefoot and firmly erect, with head, shoulders, hips and heels against a wall; not in the frequent rather slack position against the rod attached to weighing scales. The former procedure seems to be that most approved in the literature, and has recently been the subject of the following comments:

Affleck [4] in 1920 stated that some observers advocate attempting to secure the "habitual" standing posture, but that in his experience much more uniform results are obtained by having the pupil "stand tall" or "stretch up"; and he added that "this is the one test in which encouragement of the pupil to do his best may be advised."

Wilder [5] in 1920 made another point: As a purely academic question the arguments seem about equally balanced, with possibly a little more weight upon the side of the horizontal position; yet the arguments against this position are so cogent from a practical standpoint that at the International Congress of 1912 at Geneva the upright position was adopted as a part of the prescription.

Sitting-Height.—A box was placed against the wall. Each boy, stripped, was asked as he sat down to lift his hips well back against the wall, and, if his heels were not on the floor, to slip his feet forward. The purpose of this was to relax the leg muscles and thus approximate as nearly as possible, within the directions usually given for sitting-height, the rule for stem-length. In spite of this effort, the sitting-height proved inconstant as will be shown later.

Stem-Length.—For this we obeyed the enjoinder of Walker in 1916 [6]: The length (λ) is measured by seating the subject on the floor or on a low table (not a chair) with the back against the wall. Care is taken to see that the sacrum is in contact with the wall, and the legs somewhat drawn up, so that the individual sits fairly upon his ischial tuberosities. Under these conditions the height of the top of the head gives a true measurement of the length of the body, and one

4. Affleck, G. B.: Pedagogical Seminar **27**:324 (Dec.) 1920.

5. Wilder, H. H.: A Laboratory Manual of Anthropometry, Philadelphia, 1920.

6. Walker, E. W. A.: Proc. Roy. Soc. Lond. B **89**:157 (Jan. 1) 1916.

which is constant and incapable of variation by the subject. If a chair or other form of seat be employed in taking this measurement the individual can by "sitting low" or "sitting high" produce at will a variation of as much as 3 or more per cent. But, since a subject conscious that he is being measured for height tends naturally to produce a full measurement, it will be found that he intentionally "sits up," straightening the spine, tilting the pelvis forward, and rests on the contracted muscles of the thighs and buttocks instead of on his ischial tuberosities. The apparent length—"sitting height," as it has been termed—is thus increased by between 2 and 3 per cent. above the measurement taken in the manner already described. Accordingly, measurements taken on a seat require to be corrected down appropriately before they can be treated as comparable with the measurements of body length in infants or animals.

A useful complement is the following abstract from Dreyer and Hanson[7]: The subject places the backs of the fingers on the platform on which he sits, and, with the fingers pointing backward and the knees flexed, lifts the lower portion of the body gently backward until the lowest bony portion of the os sacrum is in contact with the front of the measuring standard. The back is then straightened until the back of the head comes into contact with the standard. It will be found that different persons require to bend the knees in different degrees in order to achieve this position. The head should be tilted neither up nor down and the eyes should look straight forward.

For the present study these measurements were made personally, but though unusual, they seem practicable in any school, judging both by our own and by the more extensive experience of Porter[8] in 1893, who wrote that the larger part of the measurements were made by teachers, whose hearty cooperation and efficient service in this work should earn them the gratitude of every friend of science.

TECHNIC OF MEASUREMENT USED BY OTHERS

It is very important to determine the best of the many possible trunk lengths, according to Wilder;[5] and he added that "the symphysion (pubis) does not give full value to the physiological trunk, since it omits the lower part of the pelvic girdle, which should be included down to the plane of the sciatic tuber or the end of the coccyx. At present . . . the choice rests much in favor of the tuber."

This inferiority of the symphysis pubis as a landmark is supported by evidence recently published. Measuring to the sciatic tuberosities, as urged by Walker, Dreyer, Hanson, and Wilder, I think is the most

7. Dreyer, G., and Hanson, G. F.: The Assessment of Physical Fitness, London, 1920; reprinted by Hoeber, New York, 1921.

8. Porter, W. T.: Tr. Acad. Sc., St. Louis **6**:249 (Nov. 14) 1893.

accurate practice. But even this measurement has been confused by the different technic used by sundry observers. Most have measured the sitting-height on a stool or bench in roughly (but not exactly) the same manner (e. g., Porter 1893, West [9] 1894). Koganei [10] seated his subjects with legs crossed in Turkish fashion, thus obtaining values said to be smaller by several centimeters than values with the stool method.

A few have specificially measured the stem-length (only Walker, Dreyer and Hanson, Gray and Root [1]).

Wilder has clung to the term sitting-height as used by most observers but has defined a technic which differs from theirs and in fact seems to correspond to stem-length. His technic therefore conforms to our ideal of precision but his change in usage of the term sitting-height is to be deplored. So also is Dreyer's preference to stem-length of the old title trunk-length, because that name, though used since Sappey's paper was published in 1875 for the "central portion of the body," has been measured in such a variety of ways.[11]

To illustrate, Porter took the height-sitting as the height from the crown of the head to the chair on which the child sits erect. West in his well-known investigations was slightly more particular, with the individual sitting pretty well back on a flat chair, the arms folded on the chest, the trunk erect. Hrdlicka [12] went a step further in exactitude: the height from the floor of the bench is most serviceably 50 cm., for shorter people and especially children the bench must be lower, the aim being for the thighs of the subject to be flexed at right angles to the trunk.

When measured with a bench from 30 to 40 cm. high, according to the 1912 Geneva agreement, as given in the official report by Duckworth,[13] the sitting height more nearly approximates the stem-length.

Finally, the sitting-height most nearly approximates the stem-length, and may, indeed, be identical, when measured with the knees bent up, as apparently done by Godin [14] (Busté = Vertex à ischion), by Ranke [15] Si = tubera ischiadica bis Scheitel), by Mall [16] (1907) (crown-rump), and by Wilder (sitting-height): the subject should be seated on a low,

9. West, G. M.: Arch. f. Anthropol. **22**:13, 1894.

10. Koganei, Y.: Mitth. a. d. med. Fac. d. Kaiserlich-Japanischen Universität, Tokio **2**:256, 1894.

11. Sappey, P. C.: Traité d'anatomie descriptive, Paris, Ed. 3 **1**:4, 1875.

12. Hrdlicka, A.: Anthropological Investigations on One Thousand White and Colored Children of Both Sexes, The Inmates of the New York Juvenile Asylum, New York, 1899.

13. Duckworth, W. L. H.: Am. J. Physical Anthropology **2**:61 (Jan.-March) 1919.

14. Godin, P.: Recherches anthropometriques, Paris, 1903; Bull. et mém. Soc. d'anthropologie de Paris, S. 6e **1**:268 (June 16) 1910.

15. Ranke, O.: Ztschr. f. Schulgesundheitspflege **18**:719, 734, 816, 1905.

16. Mall, F. P.: Anat. Rec. **1**:128 (Aug.) 1907.

level table . . . If the feet be placed on a rather high chair, thus lifting the dorsal muscles of the thigh from contact with the table, they cannot be used by the subject in lifting the body, while it rests directly on the sciatic tubers (ischiadic tuberosities), here quite subcutaneous.

In the interest of lucidity it seems to me essential to realize that (1) Sitting-height has not been a uniform measurement because it has in general included a considerable but variable (a) thickness of buttock muscle, and (b) curvature of the spine; (2) stem-length is a uniform measurement because it includes a minimal and (on repeated observations on the same subject, even by different observers) surprisingly constant (a) muscular layer and (b) erectness of the spine.

It is, therefore, necessary to discriminate sharply between sitting-height and stem-length, as will be seen in Chart 1 on the difference between the two measurements in the present series of 114 boys.

METHODS USED HERE TO PRESENT DATA

Averages.—The individual cases are omitted to save space and the only value shown is their average (arithmetic mean) for each age-group.

Within each group, however, variability is to be expected. While a measure of variation is eminently desirable, the coefficient of variation (C.V.) and even the range (according to Yule[17] a much inferior measure of variation) have not been listed here, owing to the relatively small number of subjects in each group. This calculation (C.V.) must be left for some observer with a larger series of observations at his command.

Absolute and Relative Measurements.—Physical measurements are frequently examined in two ways: actual values and proportional values. In conformity with this practice, the present new data will be shown first as (averages of) the absolute figures for each age, then as the ratios (indices) sitting-height to stature (Si:H) and stem-stature (λ / H).

The term "essential stature" has been credited to René Collignon of the French school (reference not discovered) by Montessori.[18] Regarding the index of stature (Si / H) the latter authoress gives the following summary: "The essential stature very slightly exceeds 50 per cent., oscillating between 53 and 54; yet it may fall to 47 or even lower, or it may rise above 56 . . . Hence, we may distinguish the type of stature by the name of brachyscelous (Manouvrier) when

17. Yule, G. U.: Introduction to the Theory of Statistics, London, Ed. 5, 1919, p. 133.

18. Montessori, M.: Pedagogical Anthropology, Translated from the Italian by Cooper, F. T., New York, 1913, p. 84.

the trunk is preponderant; and when the type is the opposite, that is, with long legs, by the name of macroscelous; reserving the term mesatiscelous to designate the intermediate type." Montessori goes on to discuss these types of stature according to total stature, to race, to social condition, in art, and in the two sexes.

COMPARATIVE SITTING-HEIGHTS AND STEM-LENGTHS IN ONE HUNDRED AND FOURTEEN BOYS

The general relationship between the sitting-height and the stem-length is visible in Chart 1, where the stem-length is assumed to be

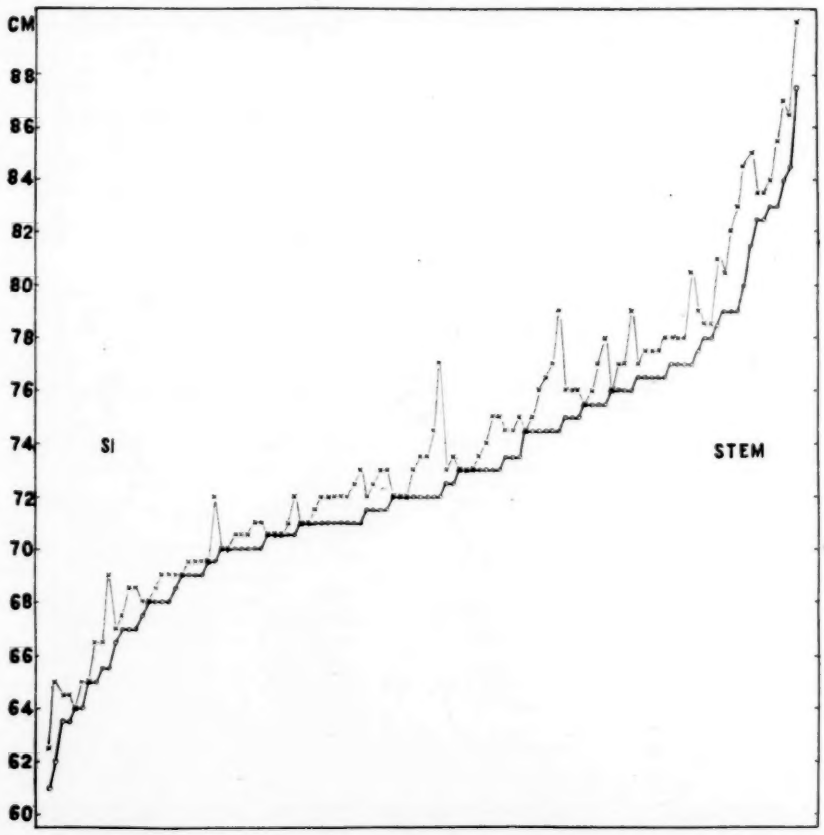

Chart 1.—Comparative sitting-heights and stem-lengths in 114 boys.

the standard value and the 114 cases are plotted seriatim from left to right, beginning with the smallest at the left.

The vertical scale of centimeters shows the size of the actual measurements of stem-length (0), and the sitting-heights (x) corresponding, i. e., those of the same subjects.

The following conclusions are obvious:

1. The sitting-height as measured in the usual way with the thighs horizontal, is never less than the stem-length, seldom equal, and nearly always greater.

2. The difference is inconstant.

This difference may be analyzed more accurately numerically in Table 1, which shows that the modal (commonest) divergence was

TABLE 1.—Difference Between Sitting-Height and Stem-Length in One Hundred and Fourteen Country Day Schoolboys (Rivers School)

Difference in cm.	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
Number of boys showing difference named	21	21	33	16	5	7	4	3	1	2	1

1 cm., the average 1.2 cm., and the range of the divergence was from 0 to 5 cm. This two-inch difference is startling. Of the fact I feel certain, for I measured the stem-length directly after the sitting-height, and whenever the difference was less than 0.5 cm. or more than 2 cm. I repeated both measurements.

Sitting-Height (Absolute).—The average sitting-height for each age ("birthday norm") is shown in Table 2.

TABLE 2.—Absolute Values in Centimeters for Sitting-Height and Stem-Length

Age Nearest Birthday	Number of Boys	Sitting Height		Stem-Length	
		Smedley	Gray	Gray	Ranke
6	3	62.4	63.8	62.3	60.0
7	6	64.7	66.8	65.9	62.9
8	16	66.8	69.7	69.2	64.8
9	19	68.8	71.6	70.6	66.0
10	16	70.6	73.2	72.5	68.9
11	19	72.1	74.2	73.2	70.2
12	13	73.8	76.8	75.5	71.2
13	10	76.2	77.7	75.6	73.6
14	3	79.2	78.5	75.8	76.0
15	4	82.2	83.9	81.1	78.5
16	3	85.4	84.5	81.0	
17	(1)	88.2	(90.0)	(87.5)	
18	(1)	90.3	(87.0)	(84.0)	

In recording the ages the nearest birthday was used here as in previous studies. It has accordingly been necessary, when abstracting for comparison the results of other writers, to adjust those results if originally tabulated according to the last birthday. This adjustment has been speculative in some cases when the writers did not specify which birthday they used.

Comparison of the new averages with some collected from the literature is interesting. The new averages run about 2.4 per cent.

above those of Smedley [19] which come the nearest and are therefore also presented in Table 2. Smedley's seem to be the only figures on the class in question—American private schoolboys. The other authors' series correspond in approximately the following order: nearest West, then Hastings,[20] Peckham [21] (pure American but class not clear), Bertillon,[22] Porter, and Hrdlicka.

For graphic comparison the values of these seven prior observers were charted, but the curves intertwined so bewilderingly that on the score of clearness the plotted points were pricked through on to another sheet (Chart 2). The dots were then blackened, tracing paper was laid

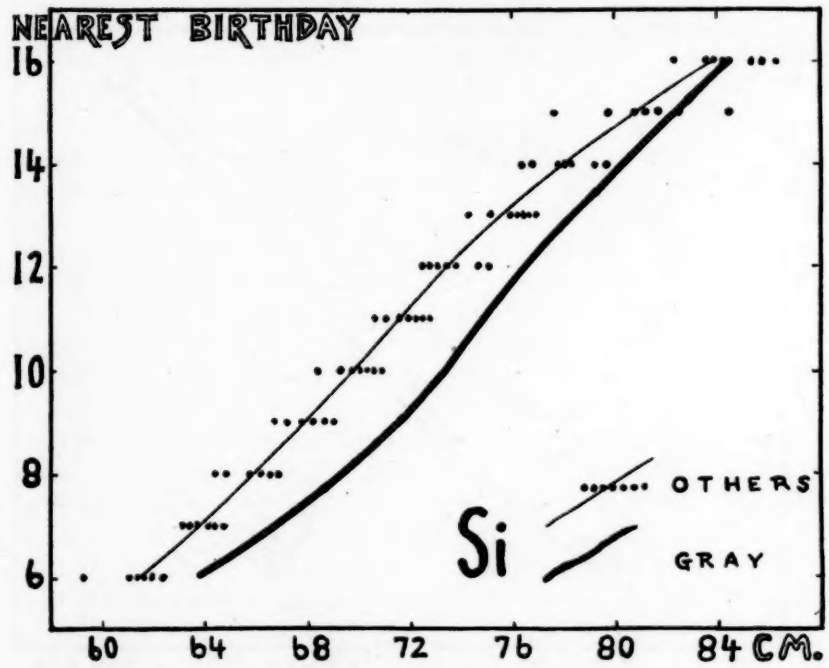

Chart 2.—Sitting-height for age.

on and a smoothed curve was drawn. Using two fresh tracing sheets, two more curves were sketched by independent observers. These three smoothings were then overlaid and as they nearly coincided, a composite was easily drawn by the eye and was then transferred also to

19. Smedley, F. W.: Forty-Sixth Annual Report, Board of Education, Chicago, 1900, p. 47.

20. Hastings, W. W.: Manual for Physical Measurements, Springfield, 1902.

21. Peckham, G. W.: Sixth Annual Report, State Board of Health of Wisconsin for 1881, Madison **6**:28, 1882.

22. Bertillon, A.: Annuaire statistique de la ville de Paris, for 1887. Published 1889 **10**:856.

Chart 2. This free-hand procedure, while not mathematically exact, as discussed elsewhere,[2] is adequate to illustrate the general trend of a field of plotted points.

In Chart 2 the composite for the prior observers is shown by the light line, while the heavy line represents my new averages.

Two deductions are plain:

1. Individual earlier observers (black dots) differ relatively little from one another. It must be remembered (a) that the extreme right hand dots on each line do not all belong to one curve and the extreme left dots to another (which would indeed indicate a difference between

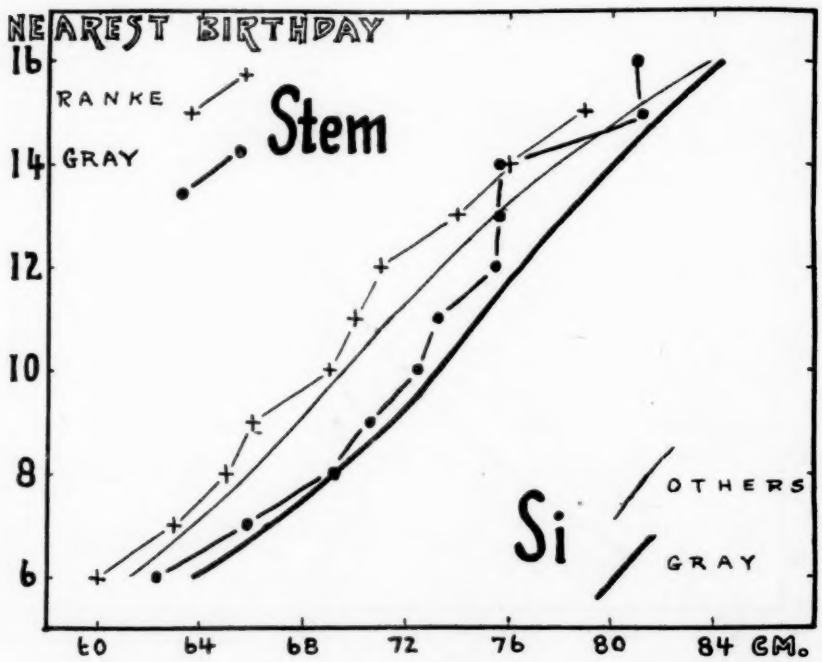

Chart 3.—Stem-length for age with, for comparison, the sitting-height curves from Chart 2.

them as great as the difference between the right dots and my heavy line), but (b) that the curves interlace almost inextricably.

2. The average of prior observers (thin line) differs notably from the new values (thick line). The latter sitting-heights are greater except at ages 15 and 16 years.

Stem-Length.—The actual stem-length for each age is averaged in Table 2. Graphically these averages are reproduced (heavy dot-dash line) in Chart 3. For comparison, the literature appears to afford no stem-lengths. Still the measurements of Ranke, 1905, were supposed

to represent the distance vertex to tuberosities, and, therefore, may be considered the nearest comparable values. So they also are given in Chart 3 (cross-and-dash line), together with the precise sitting-height line from Chart 2 (for contrast drawn as smooth curves instead of broken lines).

The lesson of the chart is that private schoolboys show a markedly greater stem-length than do Ranke's,[7] except at age 14, where the lines coincide. The excess in stem-length of my boys over his, by calculation from the table, averages 4.4 per cent. (above Ranke's values).

Proportional Sitting-Height, Sitting-Height Index (100 *Si/H.*)—The index of sitting-height was elucidated by West.[9] His more important inferences may be seen in the following extracts:

> The curves, starting at a high per cent. at 5 years of age, drop rapidly until the twelfth year in the case of girls and the fifteenth in the case of boys. . . . These movements of the curves seem to indicate that the greater part of the growth in stature, up to the twelfth year in the case of girls and until the fifteenth year in the case of boys, is made in the lower limbs, while after these respective ages it is made in the trunk.
>
> Girls grow more rapidly than boys up to 12 years of age, less rapidly after that age. . . . Although both sexes make greater annual rates after than before 12, yet the girls make their greatest absolute increase before, the boys theirs after that period.
>
> These results seem conclusive evidence that women reach maturity several years before men. There seems little doubt that for all the measurements of the body, except the weight, girls have completed their growth by the eighteenth year.

Hrdlicka drew like conclusions, but expressed in terms of leg instead of in terms of trunk: "In children of small age the proportion of the length of the lower limbs to the total height of the body is comparatively small, and increases with considerable . . . regularity during all the years up to and possibly even beyond the age of puberty. This means that as a child advances in life its limbs are growing in proportion somewhat more rapidly than its body."

Hrdlicka outlined an observation and interpretation which are upheld by the present data. He wrote: "When I compare my sitting-height indexes with similar indexes obtained by Dr. West, it appears that the indexes of Dr. West's children were at all ages somewhat smaller or that the lower extremities in these children were at all ages somewhat longer than they are in our children in the asylum. . . . These figures make me think that it is possible that it is in the lower extremities where lies the principal defect in the growth of badly nourished children; but I can say nothing positive on this point."

Following this surmise by Hrdlicka, the present series of well-to-do children would be expected to display even smaller indices than was the case with West's children. Table 3 records my values, while Chart 4 demonstrates by their relation to other series that this expectation is a fact. In other words, these private schoolboys surpass public school children, and still more asylum children of the same age, not only in standing-height and in sitting-height, but also in relative length of leg; that is, they have longer legs for their height than less fortunate children.

Incidentally, it is puzzling that the curve nearest to Hrdlicka's asylum children is shown by Smedley's children, although these were

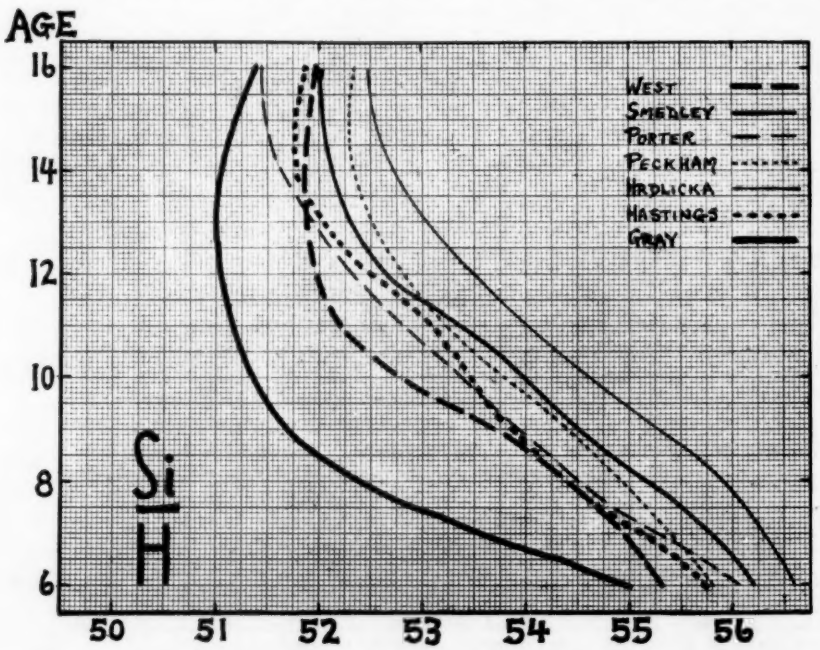

Chart 4.—Proportional sitting-height. Index: 100 Si: H.

American private schoolboys like mine, and revealed next to mine the greatest absolute sitting-heights.

Another suggestion of Hrdlicka's was that the proportions of sitting-height to total body-height can be illustrated to further advantage when we cease to consider the ages of the children and consider simply the stature. Therefore, he exposed the sitting-height index in its relation to every increase of 50 mm. in stature and from these values he drew the inference that "the relation is quite regular." However, his preferred curve as related to stature has certain irregularities that seem to me to prevent the curve from being strikingly smoother than the curve related to age; and similarly when plotted for my

children the index-curve for stature is so little smoother than the index-curve for age that the graph is not worth reproducing at present.

Theoretically, none the less, if the Si / H index should receive further study, it might well be from Hrdlicka's viewpoint, which is in keeping with the experience of several students of child physiology, as summarized elsewhere, that weight should be studied no longer in regard to age but in relation to some body measurement such as height.

Proportional Stem-Length.—A stem-length index may be examined from two angles: (1) a stem-stature index ($100\,\lambda / H$), and (2) a stem-sitting-height index ($100\,\lambda : Si$). For the new material these two series of values are condensed in Table 3, against the time when sitting-height may be supplanted by the more reliable measurement of stem-length.

TABLE 3.—INDICES OF SITTING-HEIGHT AND STEM-LENGTH (ONE HUNDRED AND FOURTEEN PRIVATE SCHOOLBOYS)

Age Nearest Birthday	Si / H	λ / H	λ / Si
6	54.6	53.7	98.1
7	54.6	53.7	98.6
8	52.6	52.1	99.1
9	51.6	51.1	98.8
10	51.3	51.0	99.1
11	51.3	50.7	98.8
12	50.6	49.9	98.6
13	51.6	50.0	97.3
14	50.3	48.4	96.7
15	51.2	49.8	97.1
16	51.4	49.0	96.1
17	50.0	49.0	97.0
18	50.0	49.0	97.0
Average	51.7	50.9	98.5

All the possible elucidations of Table 3 need not be developed here, since they are analogous to those given above for the better known measurement, sitting-height. It will suffice to note the following findings:

The average index λ / H in 114 children was 50.9, which may be compared with 51.7, the average of simultaneous observations on forty-seven healthy adult men. In ordinary speech, these children had their height distributed slightly more in the legs than was the case with the adults. This is contrary to the usual belief, as pictured in Stratz's well known diagrams,[23] that children have relatively short legs, I have no explanation to offer other than (1) accident due to the small size of both child and adult groups, or (2) that perhaps Stratz was wrong.

The mean index $\lambda : Si$ for the 114 boys was 98.5, that is, the stem-length averaged 98.5 per cent. of the sitting-height, which may be compared with 97 per cent. for adults reported by Walker.

23. Stratz, C. H.: Darstellung des menschlichen Körpers, Berlin, 1914.

SUMMARY

Height measurement is being rivalled and possibly superseded by measurements of the trunk independent of the legs.

The best trunk-lengths seem at present "sitting-height" and "stem-length," which are extremely similar.

These two measurements are here reported for 114 picked upper class schoolboys.

The sitting-height was not constantly parallel to the stem-length; for while it averaged half an inch greater, it varied anywhere from being identical in some boys to two inches greater in others.

The stem-length was found easier to measure accurately, i. e., with more constant agreement on repeated measurements.

The absolute values, both of stem-length and sitting-height, averaged according to age, showed greater values than any discovered in the literature. This is natural considering the advantages enjoyed by the present group of boys. In Hornor's words,[24] men can be bred as well as horses.

The proportional sitting-heights, or sitting-heights related to stature, or indices, were markedly less than those in the literature. This means that well-developed children have longer legs for their height than children retarded in growth; or, in Hrdlicka's words, that the principal defect of growth in badly nourished children lies in the lower extremities.

The proportional stem-lengths (indices $\lambda : H$) are also reported here but cannot be compared, as no stem-lengths for age have been detected in the literature.

It is believed that stem-length should replace sitting-height measurements in the fields of anthropology and school hygiene.

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24. Hornor, A. A.: To whom I am indebted for many helpful criticisms.

THE PRESENCE OF FORMIC ACID IN THE URINE OF INFANTS AND OLDER CHILDREN*

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Formic acid has been found in the urine of normal adults by several investigators.[1] With the intention of studying its presence in the urine of children, we examined fifty-six specimens from ten infants and nine older children for a period, in most cases, of three days each. The patients were suffering from various diseases (Tables 1 and 2). The urine in all cases was negative to copper reduction tests.

The method of Autenrieth for the determination of formic acid in the urine was used. Three hundred c.c., or less, of urine, was distilled over a free flame, after the addition of 30 c.c. of 25 per cent. phosphoric acid, until about 75 c.c remained in the flask, which was then filled to the original volume by water from a separatory funnel. The distillation was continued until the distillate was no longer acid to litmus (about 1,200 c.c. in our experiments). The distillate was then evaporated to a small volume and treated with mercuric chlorid. Formic acid, by virtue of its strong reducing power, converts mercuric chlorid to mercurous chlorid, which is filtered on a Gooch crucible and weighed. Each gram of mercurous chlorid obtained represents 0.0977 gm. formic acid. Autenrieth found that the average twenty-four hour output of formic acid by a normal adult is 0.28 gm. Another normal adult excreted 0.091 gm. in twenty-four hours. We used this method because of our inability, for several months, to secure suitable apparatus for ether

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* The investigation was carried on in the Otho S. A. Sprague Memorial Institute Laboratory of the Children's Memorial Hospital, Chicago, and in the Section on Pediatrics of the Mayo Clinic under the direction of H. S. Amberg, Rochester, Minn.

1. Autenrieth, W.: Ueber den Ameisensäuregehalt des Harns, normalerweise und nach Eingabe verschiedener Substanzen, München. med. Wchnschr. **66:** 862, 1919.

Dakin, H. D.; Janney, N. W., and Wakeman, A. J.: Studies on the Conditions Affecting the Formation and Excretion of Formic Acid; the Estimation of Formic Acid in Urine, J. Biol. Chem. **14:**341, 1912.

Riesser, O.: Bieträge zur Frage der Ameisensäurebildung und Ausscheidung, Ztschr. f. physiol. Chem. **96:**355, 1915.

Strisower, R.: Ueber die Ausscheidung der Ameisensäure menschlichen Urine in physioloischen und pathologischen Zuständen, Biochem. Ztschr. **54:** 189, 1913.

TABLE 1.—Formic Acid in the Urine of Infants

Case	Age, Mos.	Diagnosis	Date, 1920	Weight Lb. Oz.	Urine, C.c.	Sp. Gr.	Formic Acid Mg.	Formic Acid Average for 3 Days, Mg.	Diet	Stools	Remarks
751 P. P.	4	Gastro-enteritis	9/26	8 14	270		6.67		Whole milk..... 10 oz. Boiled water..... 10 oz. } 5 oz. × 4 Dextrose maltose..... 1 oz.		Convalescent intoxication; received injections of glucose acacia
			9/27	8 14	285	1.004	5.02				
			9/28	8 10	205		3.65	5.11			
									Albumin milk (Hoos) 9 oz. Dextrose maltose..... 0.25 oz. } 4.5 oz. × 2 Cereal..... 1 oz. × 1		
751 P. P.	5	Gastro-enteritis	10/ 2	9 0	190		3.33		Whole milk..... 16 oz. Boiled water..... 11.5 oz. } 5.5 oz. × 3 Dextrose maltose..... 1 oz. Cereal..... 1 oz. × 2	Normal 1 to 2 daily	Convalescent intoxication; infection originating in the ears; died 10/27/20
			10/ 3	8 13	210		5.31				
			10/ 4	8 14½	210	1.007	7.29				
			10/ 8	8 12	200	1.006	5.11	5.31			
239 J. G.	5	Gastro-colitis	9/29	8 7	285	1.008	11.46		Albumin milk (Hoos) 12 oz. Boiled water..... 9 oz. Dextrose maltose	Normal 1 to 2 daily	Moderately severe entero-colitis; improved, discharged
			9/30	8 5	265	1.008	8.59				
			10/ 1	8 5	125	1.011	2.71				
			10/ 6	8 4	135	1.006		7.58			
261 H. J.	6	Atrophy	10/12	8 1½	310	1.006	13.99		Albumin milk (Hoos). 24 oz. Dextrose maltose..... 1 oz. } 4 oz. × 6	Normal 1 in 2 to 3 days	Marasmus; improved, discharged
			10/13	8 ½	370	1.008	16.62				
			10/14	8 4	230	1.007	8.03	12.54			
261 H. J.	6½	Atrophy	10/25	8 0	295	1.010	25.13		Whole milk..... 15 oz. Water..... 10 oz. Farina..... 1 oz. } 4 oz. × 6 Dextrose maltose..... 1 oz.	Normal 1 daily	
			10/26	8 0	300	1.008	5.04				
			10/27	8 8	295	1.006	8.63	12.60			
235 C. L.	2	Entero-colitis	10/12	6 8	240	1.006	6.73		Albumin milk (Hoos) 18 oz. Boiled water..... 6 oz. } 4 oz. × 6 Dextrose maltose..... 1 oz.	Loose 1 daily	Mild diarrhea; improved, discharged
			10/13	6 8½	240	1.004	2.42				
			10/14	6 9	375	1.005	6.51	5.22			
246 C. V.	8	Entero-colitis	10/15	7 15	335	1.008	9.03		Whole milk..... 10 oz. Boiled water..... 10 oz. Dextrose maltose..... 1 oz. } 4 oz. × 5 Maltose soup..... 0.5 oz.	Normal 1 to 2 daily	Probably infantilism; improved, discharged; gained well
			10/17	8 1½	430	1.006	7.31				
			10/18	8 ½	280	1.007	7.60	8.31			
268 J. G.	7½	Atrophy	10/18	7 10½	370	1.006	6.34		Whole milk..... 15 oz. Water..... 12 oz. Farina..... 1 oz. } 4.5 oz. × 6 Dextrose maltose..... 1 oz.	Normal 1 to 3 daily	Marasmus; improved, discharged
			10/19	7 13½	360	1.005	21.06				
			10/20	7 10½	205	1.008	10.45	12.61			
754 W. G.	8	Gastro-enteritis	10/25	11 7½	360	1.008	9.07		Whole milk..... 12 oz. Boiled water..... 12 oz. } 4 oz. × 6 Dextrose maltose..... 1 oz. Cereal..... 0.5 oz. × 6	Normal constipated	Dyspepsia; improved, discharged
			10/26	11 5	260	1.006	7.38	8.22			
240 R. K.	2	Entero-colitis	10/30	8 3	220	1.010	3.44		Albumin milk (Hoos) 24 oz. Dextrose maltose..... 1 oz.	Loose 2 to 3 daily	Improved, discharged
			10/31	8 3½	195	1.012	3.01	3.22			
188 R. B.	5	Otitis media	10/19	14 0	140	1.010	7.12		Whole milk..... 18 oz. Boiled water..... 12 oz. } 6 oz. × 5 Dextrose maltose..... 1 oz.	Normal 1 to 2 daily	Severe enteritis and meningitis; died 10/31/20
			10/20	14 0	340	1.007	21.28				
			10/22	14 0	190	1.010	21.20	16.50			

TABLE 2.—Formic Acid in the Urine of Children

Case	Age, Years	Diagnosis	Date	Weight, Pounds	Urine, C.c.	Specific Gravity	Formic Acid		Diet	Remarks
							Mg.	Average for Three Days, Mg.		
243 F. G.	7 5	Chorea	11/ 3/20	45.5	235	1.030	6.83		General, soft	Patient improved, in bed; treatment for chorea
			11/ 7/20		845	1.018	19.37			
			11/ 8/20		840	1.012	6.15	10.78		
710 A. S.	4.5	Lobar pneumonia	11/ 3/20	34	325	1.026	5.38		General	Convalescent pneumonia; patient up and about in the ward
191 L. E.	2.25	Otitis media	11/17/20	25	460	1.030	4.41		General	Up and about ward
			11/18/20		390	1.022	10.09	7.25		
172 T. J.	7	Cervical adenitis	11/ 8/20	50	820	1.023	19.32		General	Tonsils and adenoids removed; condition good
2844 M. B.	8	Enlarged tonsils and adenoids	11/ 9/20	47	810	1.012	4.44		General	Chorea improved, patient in bed
			11/10/20		790	1.019	12.59			
			11/11/20		1025	1.015	6.66	7.89		
245 R. P.	8.5	Chorea	11/12/20	48	975	1.014	11.95		General	Chorea improved; patient in bed
			11/13/20		500	1.018	14.81			
			11/14/20		840	1.012	12.7	13.15		
246 G. W.	9	Chorea	11/15/20	58	275	1.010	6.63		General	Chorea moderately severe; patient in bed
			11/16/20		700	1.012	9.22			
			11/17/20		450	1.012	8.01	7.95		
242 E. M.	10.75	Chorea	11/ 9/20	65	570	1.030	22.80		General	Improved; up and about ward
			11/10/20		790	1.019	31.03			
			11/11/20		1045	1.016	39.43	31.08		
215 T. H.	10.5	Chorea	11/12/21	57	750	1.020	11.82		General	Chorea improved; patient in bed
			11/13/21		700	1.020	15.62			
			11/14/21		830	1.020	19.39	15.61		

extraction of fluids. When, later, control experiments were made with the Lind apparatus, our results indicated the presence of formic acid in the urines analyzed by the former method. Dakin, Janney and Wakeman, working with the ether extraction method, found the average amount of formic acid in the urine of adults to be only 60 mg., with variations from 29.9 to 118.6 mg.

Any method involving distillation with acids is open to objection because formic acid may be derived from glucose and, perhaps, from other substances. There is no doubt that during the distillation some formic acid can arise from this source, as was shown by an increase

TABLE 3.—Formic Acid Determinations

Experiment	Autenrieth Method, Mg. for Each 100 C.c.	Ether Extraction Method, Mg. for Each 100 C.c.
1	3.27	3.40
2	2.37	2.17
3	3.62	3.96
4	2.73	2.81
5	4.93	3.93
6	2.16	2.15

in the formic acid determinations of a specimen of urine from 21.7 to 106 mg. after the addition of 2 per cent. glucose. On the other hand, such a formation of formic acid apparently need not always occur, as is shown by the results obtained with parallel determinations of formic acid by the acid distillation method of Autenrieth and the ether extraction method (Table 3).

While the Autenrieth method is open to objections, the results obtained by parallel determination with the ether extraction method have been so close that we can safely conclude that the urine of children does in all likelihood contain formic acid.

THE PROPHYLACTIC AND THERAPEUTIC VALUE OF PERTUSSIS VACCINE*

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The prophylactic and therapeutic value of pertussis vaccine was demonstrated recently when an epidemic of pertussis broke out among the female inmates of the Syracuse State School for Mental Defectives. Children are 7 years of age before they are admitted to the school. The majority of the inmates are of a grade of intelligence which enables them to care for their bodily needs, but in a disease such as whooping cough, in which paroxysms occur suddenly and frequently, and are accompanied by vomiting, these mental defectives are at a disadvantage in caring for themselves.

The epidemic gained access to the institution through the agency of a little girl, who, as we discovered later, came from a territory in which the disease was prevalent at the time she was admitted to this institution. The usual procedure of placing a new admission in quarantine for two weeks was observed in this instance. The girl had a slight cold and the cough was not paroxysmal in type. She also had enlarged tonsils, and the physical findings of a mild bronchitis were elicited. She did not expectorate, vomit or whoop. At the end of two weeks she was coughing slightly, therefore quarantine was extended another week. She was a nervous child and for behavioristic reasons isolation for a longer period seemed unwarranted. She was placed in a class in the main building with thirty-one other children of about her own age. Other children in this class were coughing, but none sounded suspicious of whooping cough.

One month after our patient was released from quarantine the first whoop was reported, and in the following week several children were reported whooping, our new admission being among them.

The main building is of the old type in which the dormitories of the various classes are connected and the children housed there work and play together. It was quite probable that 177 girls had been exposed to the infection. In all, thirty-three girls were removed to the quarantine ward of the hospital with a positive diagnosis of pertussis.

The diagnosis was made in the cases which first showed symptoms of an ordinary cold and cough. In the initial stages several children had temperatures ranging as high as 100 F. There was a cough

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which became paroxysmal in type, with the physical findings of a simple bronchitis. The spasmodic character of the cough was not marked from the onset, but the whoop was noted in the majority of the cases from the beginning. The paroxysms ended with the ejection of a thick mucus and vomiting. No cultures of the expectorations were made. Smears of the expectoration in Cases 2, 7, 13 and 27 showed a gram-negative, short bacillus scattered among the pus cells. We did not attempt to examine the expectoration in all cases because of lack of time and facilities, but depended on clinical findings for a diagnosis. There were some cases which showed marked clinical evidence of pertussis in which the gram-negative, short bacillus was not found. The facies of our patients were characteristic. Swelling, congestion, injected conjunctivae, with puffy eyelids, were noted.

The New York State Department of Laboratories furnished us with sufficient vaccine to give prophylactic doses to all children who we believed had been exposed to the infection. The vaccine was dated May 2, 1921, three months before it was used (Series 39-H). On careful survey of the records and histories of the 177 girls, we found that twenty had already had the disease, 114 had not had the disease, and in forty-two cases the history and records were inadequate, so that we could not determine whether these children had had the disease. Twenty-seven of the children who developed whooping cough had not had the disease before and the remaining six were numbered among the cases in which the history and records were inadequate. In no case was there a history of a child having previously had the disease and then developing a second attack.

At the time the prophylactic vaccine injection was made we did not stop to look up past records before administering the vaccine. Three doses of vaccine were given to 143 children. The first dose was 500,000,000 units; on the third day 1,000,000,000 units were given and on the sixth day 2,000,000,000 units were injected. None of the children had severe reactions. Four of these children were sent to the quarantine ward after the first prophylactic dose was given because of the development of the paroxysmal cough with ejection of a thick mucus. Smears made from the mucus in two of these cases showed the small gram-negative bacillus among the pus cells.

The accompanying table shows the treatment and the results in the thirty-three cases in which a diagnosis of pertussis was made.

Thirteen children received five injections, one being administered every third day. The first dose was 500,000,000; the second, 1,000,000,000; the third, 3,000,000,000; the fourth, 2,000,000,000 and the fifth, 2,000,000,000. All these children persisted in coughing after the third injection; seven were coughing after the fourth injection, and six were coughing after the fifth injection. We did not give

TREATMENT AND RESULTS IN THIRTY-THREE CASES OF PERTUSSIS

Case	Diagnosis	Date of Injection	Dosage, Millions	Cough	Whooping	Vomiting	Discharge
1	Aug. 24	Aug. 24	500	+	+	+	
		Aug. 26	1,000	+	+	−	
		Aug. 29	3,000	+	+	−	
		Aug. 31	2,000	+	+	−	
		Sept. 7	2,000	−	−	−	Sept. 16
2	Aug. 24	Aug. 24	500	+	+	−	
		Aug. 26	1,000	+	+	+	
		Aug. 29	3,000	+	−	−	
		Aug. 31	2,000	−	−	−	
		Sept. 7	2,000	−	−	−	Sept. 16
3	Aug. 24	Aug. 24	500	+	+	+	
		Aug. 26	1,000	+	+	−	
		Aug. 29	3,000	+	+	−	
		Aug. 31	3,000	+	−	−	
		Sept. 7	2,000	+	−	−	
		Sept. 30	.....	+	−	−	
		Oct. 21	.....	−	−	−	Oct. 21
4	Aug. 24	Aug. 24	500	+	+	+	
		Aug. 26	1,000	+	+	+	
		Aug. 29	3,000	+	+	+	
		Aug. 31	2,000	+	−	−	
		Sept. 7	2,000	+	−	−	
		Oct. 7	.....	+	−	−	Oct. 29
5	Aug. 24	Aug. 24	500	+	+	+	
		Aug. 26	1,000	+	−	+	
		Aug. 29	3,000	+	−	+	
		Aug. 31	2,000	+	−	−	
		Sept. 7	2,000	+	−	−	
		Sept. 30	.....	+	−	−	
		Oct. 15	.....	+	−	−	
		Oct. 21	.....	−	−	−	Oct. 21
6	Aug. 24	Aug. 24	500	+	+	+	
		Aug. 26	1,000	+	+	+	
		Aug. 29	3,000	+	−	+	
		Aug. 31	2,000	+	−	−	
		Sept. 7	2,000	+	−	−	
		Sept. 30	.....	+	−	−	
		Oct. 15	.....	+	−	−	Oct. 21
7	Aug. 24	Aug. 24	500	+	−	−	
		Aug. 26	1,000	+	−	−	
		Aug. 29	3,000	+	+	+	
		Aug. 31	3,000	+	+	+	
		Sept. 7	2,000	+	−	−	
		Sept. 31	.....	+	−	−	
		Oct. 15	.....	+	−	−	Oct. 21
8	Aug. 24	Aug. 24	500	+	−	−	
		Aug. 26	1,000	+	+	−	
		Aug. 29	3,000	+	−	−	
		Aug. 31	2,000	+	−	−	
		Sept. 7	2,000	−	−	−	Sept. 16
9	Aug. 24	Aug. 24	500	+	+	+	
		Aug. 26	1,000	+	+	−	
		Aug. 29	3,000	+	+	−	
		Aug. 31	2,000	+	−	−	
		Sept. 7	.....	−	−	−	Sept. 16
10	Aug. 24	Aug. 24	500	+	+	+	
		Aug. 26	1,000	+	+	+	
		Aug. 29	3,000	+	−	−	
		Aug. 31	3,000	+	−	−	
		Sept. 7	2,000	−	−	−	Sept. 16
11	Aug. 24	Aug. 24	500	+	+	+	
		Aug. 26	1,000	+	−	+	
		Aug. 29	3,000	+	−	−	
		Sept. 7	2,000	−	−	−	Sept. 16
12	Aug. 24	Aug. 24	500	+	+	−	
		Aug. 26	1,000	+	+	+	
		Aug. 29	3,000	+	−	−	
		Aug. 31	2,000	−	−	−	
		Sept. 7	2,000	−	−	−	Sept. 8
13	Aug. 24	Aug. 24	500	+	+	−	
		Aug. 26	1,000	+	−	−	
		Aug. 29	3,000	+	−	−	
		Aug. 31	2,000	+	−	−	
		Sept. 7	2,000	−	−	−	Sept. 14
14	Aug. 24	Aug. 24	500	+	+	−	
		Aug. 26	1,000	+	−	−	
		Aug. 29	3,000	+	−	−	
		Aug. 31	2,000	+	−	−	
		Sept. 8	.....	−	−	−	Sept. 8

TREATMENT AND RESULTS IN THIRTY-THREE CASES OF PERTUSSIS

Case	Diagnosis	Date of Injection	Dosage, Millions	Cough	Whooping	Vomiting	Discharge
15	Aug. 24	Aug. 24	500	+	+	−	
		Aug. 26	1,000	+	−	+	
		Aug. 29	3,000	+	−	−	
		Aug. 31	2,000	+	−	−	
		Sept. 2	.....	−	−	−	Sept. 8
16	Aug. 24	Aug. 24	500	+	+	−	
		Aug. 26	1,000	+	+	−	
		Aug. 29	3,000	+	−	−	
		Aug. 31	2,000	+	−	−	
		Sept. 2	.....	−	−	−	Sept. 12
17	Aug. 24	Aug. 24	500	+	−	−	
		Aug. 26	1,000	+	−	−	
		Aug. 29	3,000	+	−	−	
		Aug. 31	1,000	+	−	−	
		Sept. 18	.....	−	−	−	Sept. 28
18	Aug. 24	Aug. 24	500	+	+	−	
		Aug. 26	1,000	+	−	−	
		Aug. 29	3,000	−	−	−	
		Aug. 31	2,000	−	−	−	Aug. 31
19	Aug. 24	Aug. 24	500	+	+	−	
		Aug. 26	1,000	+	−	−	
		Aug. 29	3,000	+	−	−	
		Aug. 31	2,000	−	−	−	Aug. 31
20	Aug. 24	Aug. 24	500	+	+	+	
		Aug. 26	1,000	+	−	+	
		Aug. 29	3,000	+	−	−	
		Aug. 31	2,000	+	−	−	
		Oct. 4	.....	−	−	−	Oct. 7
21	Aug. 24	Aug. 24	500	+	−	−	
		Aug. 26	1,000	+	−	−	
		Aug. 29	3,000	+	−	−	
		Aug. 31	3,000	+	−	−	
		Sept. 7	2,000	+	−	−	
		Sept. 30	.....	+	−	−	
		Oct. 15	.....	+	−	−	Oct. 21
22	Aug. 24	Aug. 24	500	+	−	−	
		Aug. 26	1,000	+	−	−	
		Aug. 29	3,000	−	−	−	
		Aug. 31	2,000	−	−	−	Sept. 5
23	Aug. 24	Aug. 24	500	+	+	−	
		Aug. 26	1,000	+	+	−	
		Aug. 29	3,000*	+	+	+	
		Aug. 31	2,000	+	+	+	
		Sept. 10	.....	−	−	−	Sept. 16
24	Sept. 12	Sept. 26	500*	+	+	+	
		Sept. 29	500*	+	+	+	
		Oct. 3	500*	+	+	+	
		Oct. 10	.....	+	+	−	
		Oct. 15	.....	+	−	−	
		Nov. 9	.....	+	−	−	
25	Aug. 24	Aug. 24	500*	+	−	−	
		Aug. 29	1,000	+	−	−	
		Aug. 31	2,000	+	+	+	
		Sept. 7	2,000	+	+	−	
		Sept. 30	.....	+	−	−	
		Oct. 15	.....	+	−	−	
		Nov. 9	.....	+	−	−	Nov. 9
26	Aug. 24	Aug. 24	500	+	−	−	
		Aug. 26	1,000	+	−	−	
		Aug. 29	3,000	+	+	+	
		Aug. 31	2,000	+	+	+	
		Sept. 7	2,000	+	−	+	
		Sept. 30	.....	+	−	−	
		Oct. 15	.....	+	−	−	
		Nov. 9	.....	+	−	−	Nov. 9
27	Aug. 24	Aug. 24	500	+	+	+	
		Aug. 26	1,000	+	+	+	
		Aug. 29	3,000	+	+	+	
		Aug. 31	2,000	+	+	+	
		Sept. 7	2,000	+	+	−	
		Sept. 30	.....	+	−	−	
		Oct. 31	.....	+	−	−	
		Nov. 9	.....	+	−	−	
28	Aug. 27	Aug. 27	2,000	+	−	−	
		Aug. 29	3,000	+	−	−	
		Aug. 31	2,000	+	−	−	
		Sept. 1	.....	−	−	−	Sept. 9

TREATMENT AND RESULTS IN THIRTY-THREE CASES OF PERTUSSIS

Case	Diagnosis	Date of Injection	Dosage, Millions	Cough	Whooping	Vomiting	Discharge
29	Aug. 27	Aug. 27	2,000	+	+	—	
		Aug. 29	3,000*	+	+	—	
		Sept. 7	2,000	+	+	—	
		Sept. 30	.....	—	—	—	
		Oct. 7	.....	—	—	—	Oct. 7
30	Aug. 27	Aug. 27	500	+	+	+	
		Aug. 31	2,000	+	—	—	
		Sept. 7	2,000	+	—	—	
		Sept. 30	.....	—	—	—	Oct. 4
31	Aug. 29	Aug. 29	500	+	—	—	
		Aug. 31	2,000	+	+	+	
		Sept. 7	2,000	+	+	—	
		Sept. 30	.....	+	—	—	
		Oct. 15	.....	—	—	—	Oct. 21
32	Aug. 29	Aug. 29	3,000	+	—	—	
		Aug. 31	2,000	+	—	—	
		Sept. 7	2,000	—	—	—	Sept. 16
33	Sept. 11	Sept. 11	2,000	+	+	+	
		Sept. 26	2,000	+	+	+	
		Sept. 29	2,000	+	+	+	
		Oct. 10	.....	—	—	—	Oct. 19

* Reaction.

more than five injections to any one child. Five children persisted in coughing four or five times a day for six weeks and continued to do so for ten weeks.

Before the first injection, twenty-three children were whooping; after the first injection only fourteen were whooping; after the second injection only nine were whooping; after the third injection, seven were whooping, after the fourth injection three were whooping and after the fifth injection none whooped. All whooping had ceased six weeks after the first injection was given.

Before the first injection, eleven children were vomiting, after the first injection, three were vomiting who had not vomited before and nine of the others were still vomiting; after the second injection, six were vomiting and three who had not vomited before began to vomit; after the third injection, four were vomiting; after the fourth injection, none were vomiting, and after the fifth injection none were vomiting.

Six children coughed paroxysmally when they were given their first injection. They did not develop a whoop. The cough persisted in these cases on an average of twenty-six days. The faces of these children were at first swollen and the conjunctivae were injected.

Of those children who were coughing and who had been exposed to the disease and had received their first prophylactic dose, severe coughs developed in Cases 2, 28 and 31. One child (Case 28) did not whoop or vomit but had a severe cough which developed after the first injection. A smear in this case stained by the Gram method showed a small gram-negative bacillus among the pus cells. After the patient was placed in quarantine, three additional injections were given and the clinical signs were less severe. No further smears of the mucus were made. The second child (Case 2) had a slight cough

when the first injection was given. This persisted, became decidedly paroxysmal in type and a whoop developed, with vomiting, within twenty-four hours. After the second injection there was no more whooping or vomiting, but the cough persisted until after the third injection was given. The third child (Case 31) was coughing slightly. She was given the prophylactic injection but the cough increased. The second injection was given and she developed a whoop and vomited. After the third injection the vomiting stopped, and after the fourth injection the whooping stopped. The cough persisted for a long time, not severe but bad enough to warrant keeping the child in quarantine.

Other children in the main building who had received prophylaxis did not develop the disease. Several had slight coughs but whether these were hysterical or otherwise was not ascertained at the time. After the children who were coughing and whooping were removed, and about a week after the initial prophylactic injection, the coughing in the main building practically stopped.

As to reactions from the vaccine, there were three cases. In Case 23 a reaction developed after the third injection. The child had a severe headache lasting throughout the night. There was no rise in temperature. Another child (Case 25) had a severe reaction after the first dose. Her temperature was 105.3 F. She had headache, backache and chills. The following morning the temperature was 99 F. and her condition was improved. She had no further reaction except a severe cough which lasted until November 9. This girl had a mitral regurgitation, resulting from an attack of influenza in 1918. The third child (Case 29) had a reaction after the second injection. Her temperature was 103.4 F. and she had headache and chills. Twelve hours later her condition was normal.

Case 27 was the most severe case we had. Paroxysms at first averaged eight a day. The child vomited and whooped with every paroxysm until after the fourth injection, and whooped until after the fifth injection. The cough persisted, was paroxysmal and November 9 she was coughing on an average of three times a day.

Pertussis is a disease which usually occurs in epidemic form and is contagious from person to person, but dwelling houses, school rooms and other localities may be infected by a sick child. Many persons possess immunity against the disease, but girls are more subject to it than boys. It has been pretty well proven that the Bordet-Gengou bacillus is the cause of the disease. This bacillus resembles the *Bacillus influenzæ*, but it is smaller. It is a gram-negative organism and is found among the pus cells and sometimes within these cells. It stains poorly, best at the ends. It seems to be established that the greatest infectivity occurs during the initial stages of the disease, and even during the active paroxysmal stage there is less

liability of infection of others, while in the later stages there is probably no infective agent present. In the initial stage the child has symptoms of an ordinary cold with a dry bronchial cough. Mild attacks of the disease are difficult to recognize. The patient may go through the whole stages without once having a typical paroxysm and never have a whoop. In some cases of bronchitis, complicated by a laryngitis, a whoop may be present which closely resembles that of pertussis. It is these cases and the atypical cases that are difficult of diagnosis.

DISCUSSION

Pertussis gained access to the institution through a child who had been exposed to the infection before admission. The disease was unsuspected and the first case was an atypical one. Of the 176 children that had been exposed to the infection 114 had not had the disease, twenty had had the disease and the records and history were inadequate in forty-two cases. Thirty-three children developed the disease. Records in twenty-seven of these cases were negative for previous attacks and doubtful in the remaining six cases. Thirty-three children were admitted to the hospital ward with a positive diagnosis of pertussis, based in the majority of cases on the clinical findings. The remaining 143 children were given prophylactic doses of pertussis vaccine regardless of previous records or histories. After the thirty-three were removed from the main building, a diagnosis of pertussis was made in only four additional cases. We are quite sure that the majority of the children were exposed to the infection and at a time when the disease was at the stage of greatest infectivity. Most of our children are very young, and since we feel that our histories and records are quite reliable, we would say that the majority had not had pertussis. It has been stated that many persons possess an immunity against the disease and it is possible that some of the girls possessed that immunity, but girls are said to be more susceptible to the disease than boys, also it has been noted that mental defectives very readily fall prey to infections of all kinds. If the disease was in its initial stages in any of the 143 cases in which prophylactic vaccine injections were given, it was evidently checked in its development for no new cases were admitted to quarantine. If any of the cases persisted as mild or atypical cases, such as the first case was, the disease was not conveyed to any of the girls from the other buildings nor to the boys when the regular session of school opened in September and all children mingle as they do in the public schools.

Although it appears that the individual child responds differently to the pertussis vaccine, the duration of the disease is shortened by its administration. The duration in light uncomplicated cases is given

as from eight to twelve weeks; the more severe cases last a longer period. Paroxysms were lessened in severity and duration, and whooping and vomiting were alleviated.

The most severe reactions occurred in children with valvular heart lesions.

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1. Osler: Practices and Principles of Medicine, Chicago, A. M. A. Press, 1921, p. 119-122.

2. Osborne and Fishbein: Handbook of Therapy, Chicago, A. M. A. Press, 1921, p. 91.

3. E. Mather Sill: Forchheimer's Therapeusis of Internal Diseases, Philadelphia, D. Appleton & Co. **5**:300, 1916.

4. Bamberger, A.: The Vaccine Therapy of Whooping Cough, Am. J. Dis. Child. **5**:21 (Jan.) 1913.

5. Hiss and Zinser: A Textbook of Bacteriology, New York and London, D. Appleton & Co., 1914, p. 543.

THE CHLORIN CONTENT OF COWS' AND GOATS' MILK AND FORMULAS COMMONLY USED IN INFANT FEEDING*

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Recent studies of foods emphasize the importance of their various salts to nutrition, and especially to the nutrition of growing animals. In starting an investigation of this subject in its relation to the nutrition of infants, it seemed necessary, first, to study the concentration of the various salts that are found in milk. The sodium chlorid content of human milk obtained from mothers at various stages of lactation and living under various conditions was first investigated by us.[1] It was shown that the concentration of this salt in human milk varied greatly, but that it was remarkably constant in the milk of mothers who gave relatively large amounts of milk and were able to nurse their babies satisfactorily. The present study concerns the sodium chlorid content of cows' milk, goats' milk, and formulas made from cows' milk that are commonly used in infant feeding.

The method employed for the determination of the amount of chlorin present was that of Van Slyke and Donleavy,[2] a slight modification of which has been described by us.[1] Five c.c. of milk was used and 10 c.c. each of picric acid and acidified silver solutions.

The specimens of whole milk examined were obtained from the Walker-Gordon dairy near Boston and from a dairy in a country district in New Hampshire. In both instances the cows were stall fed. The cows in the first dairy were giving relatively large amounts of milk and were on well established balanced rations for maximum milk production. The cows of the second dairy were giving small amounts of milk, and were fed chiefly on hay with small amounts of grain. Specimens of milk were examined from both dairies with the salt intake carefully controlled. Precautions were taken to avoid contamination from excreta. Unless otherwise stated, the specimens represent a sample of a single milking.

The materials used for the examination of cows' milk modifications were obtained from the Walker-Gordon Laboratory, the Boston Floating Hospital, the Massachusetts General Hospital and a few miscel-

* Received for publication Jan. 24, 1922.

* From the Children's Medical Department and the Clinical Laboratory of the Massachusetts General Hospital.

1. Sisson, W. R., and Denis, W.: Am. J. Dis. Child. **21**:389 (April) 1921.
2. Van Slyke, D. D., and Donleavy, J. J.: J. Biol. Chem. **37**:55 (April) 1919.

laneous sources. These specimens represent types of formulas commonly used in infant feeding.

The specimens of goats' milk were obtained from three goats which had been used for experimental purposes in our laboratory. The animals were in excellent condition when the specimens were obtained, and were receiving no extra added salt in their rations.

The results of the analyses of twenty-five specimens of milk obtained from Dairy "A" (Walker-Gordon) are shown in Table 1. Most of these cows were Holsteins and gave from ten to twenty quarts of milk a day. The first twenty cows received their usual salt ration of 30 gm. a day; the last five days in the series were given 500 gm. salt twelve hours before the specimens were obtained. It will be noted that marked variations, amounting to 104.8 per cent., occurred in the chlorin content of different specimens. The average chlorin concentration of the twenty-five specimens was 108.9 mg. per hundred c.c. milk.

TABLE 1.—SHOWING CHLORIN CONTENT OF SPECIMEN OF COWS' MILK FROM DAIRY "A" *

Cow No.	Mg. Chlorin per 100 C.c. Milk	Cow No.	Mg. Chlorin per 100 C.c. Milk
1	78.6	14	130.2
2	105.0	15	77.7
3	73.8	16	131.4
4	137.2	17	100.5
5	112.8	18	92.4
6	124.5	19	91.2
7	111.3	20	108.3
8	111.3	21	122.4
9	108.3	22	104.5
10	95.7	23	103.5
11	103.5	24	156.6
12	88.8	25	102.0
13	151.2		

* Cows 1-20 received 30 gm. sodium chlorid daily; Cows 21-25, 500 gm. twelve hours before milking.

The chlorin concentration of specimens of twelve cows of Dairy "B" (New Hampshire dairy) is shown in Table 2. More detailed data was obtained about the cows of this herd. Their approximate weight and period of lactation are shown in Table 2. Most of these cows were Jerseys that produced a relatively small amount of milk with a high fat content. The first specimens were obtained after the cows had received no added salt in their rations for a period of five weeks. It will be noted that comparatively little variation occurred in the chlorin content of the milk of these cows, and that figures much higher than those in the previous specimens of Dairy "A" were obtained. The average chlorin concentration of specimens of this dairy was 170 mg. per hundred c.c. milk. During the twenty-four hours following the collection of the first specimens of milk from the cows of Dairy "B," 500 gm. salt were given, and other specimens were obtained. The

chlorin concentration of these is shown in Table 2, and it will be seen that essentially no change took place in the chlorin content of the milk after the addition of the salt to the rations. Further determinations were made on specimens from the same cows collected twelve hours later, and these showed almost identical results.

TABLE 2.—SHOWING CHLORIN CONTENT OF SPECIMENS OF COWS' MILK FROM DAIRY "B"

Cow No.	Age, Years	Approximate Weight, Kg.	Period of Lactation	Volume Milk Daily, C.c.	Mg. Chlorin per 100 C.c. Milk*	
					1	2
1	3	350	4 weeks	8,000	175	175
2	6	400	12 weeks	7,500	150	175
3	5	375	8 weeks	7,500	172	176
4	5	400	26 weeks	5,000	175	175
5	2	310	5 weeks	7,000	155	175
6	2	350	4 weeks	6,000	175	175
7	8	440	36 weeks	1,500	175	178
8	2	375	12 weeks	7,500	176	176
9	8	450	6 weeks	12,000	175	175
10	4	440	4 weeks	12,400	175	175
11	5	350	8 weeks	10,000	161	169
12	6	350	8 weeks	8,000	178	176

* (1) after five weeks of salt free diet; (2) after ingestion of 500 gm. sodium chlorid.

The chlorin content of specimens of milk obtained from the first and last of the milking from cows of Dairy "B" is shown in Table 3. From these analyses there is no evidence that marked variations occur in the chlorin content of the milk obtained at different periods during the day.

TABLE 3.—SHOWING CHLORIN CONTENT OF SPECIMENS FROM FIRST AND LAST OF MILKINGS FROM DAIRY "B"

Number	Mg. Chlorin per 100 C.c. Milk	
	First Milking	Last of Milking
7	164.1	178.8
8	179.4	179.4
9	179.1	179.1
10	170.7	164.1
11	147.3	142.5
12	179.4	179.1
13	179.4	179.4
14	179.4	179.4
15	179.1	179.1
16	172.2	179.4

These determinations of the chlorin content of cows' milk show that marked variations of this constituent may occur, and that differences amounting to as much as 143 per cent. are frequently found. These results are similar to those described by us[1] in the chlorin content of human milk. The variations have no relation to the salt intake or to the stage of lactation or to the time of milking. Lower chlorin concentrations occur in specimens from cows giving large amounts of milk, and conversely high concentrations of chlorin occur in specimens from cows giving a small amount of milk.

In Table 4, the chlorin content of the milk of three different goats, together with their average daily volume of milk, is shown. The chlorin concentration of these specimens ranged from 124 to 189 mg. per hundred c.c. of milk. It will be noted that higher concentrations

TABLE 4.—SHOWING CHLORIN CONTENT OF MILK FROM THREE GOATS

Goat No.	Mg. Chlorin per 100 C.c. Milk	Average 24 Hour Volume of Milk, C.c.
1	165	150
1	169	
1	189	
1	153	
1	148	
1	157	
1	174	
2	125	900
2	127	
2	128	
2	124	
3	165	650
3	166	
3	167	
3	156	

were found in specimens from the goat giving a small amount of milk and lower concentrations in milk from the goat giving a large amount of milk.

The results of the examination of types of various formulas for their chlorin content are shown in Table 5. More than a hundred

TABLE 5.—SHOWING CHLORIN CONTENT OF FORMULAS COMMONLY USED IN INFANT FEEDING

Fat, per Cent.	Carbohydrate, per Cent.	Protein, per Cent.	Chlorin, Mg. per 100 C.c.
	"A" Formula Made with Whole Milk		
1.6	7.0	1.28	44.0
2.0	6.0	1.6	78.0
2.6	6.6	2.1	71.8
3.0	6.0	2.3	66.5
3.6	7.0	2.9	91.5
	"B" Formula Made with Cream and Skimmed Milk		
1.5	7.0	1.0	35.0
2.0	6.5	...	42.0
3.0	6.0	1.0	61.8
4.0	7.0	2.0	90.0
	"C" Formula Made with Cream and Whey		
1.2	6.5	90/20	144.0
1.6	5.2	80/20	141.5
2.0	6.0	90/75	112.8
2.5	7.0	90/10	137.4
2.5	6.0	90/0	151.8
	"D" Miscellaneous Formulas		
Protein milk, Boston Floating Hospital			71.5
Protein milk, (1) powdered preparation (a)			85.5
Protein milk, (2) powdered preparation (b)			47.0
Protein milk, Walker-Gordon Laboratory			141.0

different mixtures were examined and findings obtained that showed considerable variation in the chlorin content, depending on the relative amount of the various ingredients used in making up the formula. Formulas made from whole milk with a percentage of fat slightly below

2 per cent. showed a chlorin concentration about that of human milk, namely from 40 to 60 mg. per hundred c.c. The amount of chlorin in the formula increased, as would be expected, when larger amounts of whole milk necessary to increase the fat content were added. Formulas that were made from cream and skimmed milk with a fat content equal to that of a formula made from whole milk, in general showed considerably lower chlorin values, and more nearly approached the chlorin content of human milk. On the other hand, formulas that were made with whey always had a very high chlorin content. These mixtures, although the percentage of fat was not higher than 2, contained more than 100 mg. chlorin per hundred c.c. of formula, and the average chlorin concentration of all these whey formulas was 150 mg.

The chlorin content of samples of "protein milk" examined showed surprising variation. In some instances the amount of chlorin was 151 mg. The preparations of dried protein milk and those made under careful laboratory supervision uniformly showed a concentration of from 47 to 85.5 mg. per hundred c.c.

It was noted that variations occurred in the chlorin concentration not only in protein milk mixtures but in all types of formulas examined, although they contained similar percentages of fat, carbohydrate and protein, and were prepared by similar methods. This fact is best explained by inaccurate methods used to estimate the organic constituents and by variations already demonstrated to exist in the chlorin content of different specimens of milk that may have been used in the different formulas.

DISCUSSION

The standards for the proper amount of "salt" in the diet of infants under normal and abnormal nutritional conditions up to the present time are largely based on clinical experience and a lack of fundamental scientific basis. Although it is recognized that sodium chlorid is an essential ingredient of the infant's diet, the exact amount for normal nutrition has not been demonstrated.

Our clinical standards for the use of "salt" in the diets of infants have been based on the fact that there is always an excess of this ingredient in the milk and that this excess was easily tolerated. It has been assumed that although the normal intake of sodium chlorid of the infant on breast milk is from 1 to 2 gm. a day, an infant may be given a cows' milk formula containing double this amount without a deleterious effect on the nutrition. Such methods are not in accord with recognized physiologic facts, and although excessive amounts of "salt" may be tolerated, as may high percentages of fat or other ingredients, nutritional disturbances may be related in some instances to their unrestricted use. Examples of the use of excessive amounts of "salt" which are associated with pathologic disturbances may be

seen after giving formulas that contain dextri-maltose with added salt. These mixtures often contain as much as 400 per cent. more sodium chlorid than human milk, and cause what must be considered pathologic gains in weight, due undoubtedly to retention of water. Similarly, disturbances associated with diarrhea are frequently noted after the use of whey mixtures which contain excessive amounts of salts. Further clinical evidence of the retention of salt to the nutritional problems of infants may be seen from the use of protein milk. This mixture contains a relatively small amount of sodium chloride and other salts, in proportion to the other organic elements, and because of this and possibly other factors, causes marked changes in nutrition with cessation of diarrhea.

SUMMARY

The studies on the sodium chlorid content of milk emphasize the marked variation of this important ingredient in different specimens of cows' and goats' milk. Furthermore, from this study and investigation by Forbes [3] and by Denis and Sisson,[4] it seems probable that these variations are not related to the salt intake in the animal's ration, but are more dependent on the species of lactating animal and on the volume of milk that is secreted. The results of the study of the salt content of various formulas indicate that, in general, excessive amounts of the ingredient are fed to infants, and that whole milk, and especially cream and skimmed milk formulas, have a salt content nearer that of human milk, while whey mixtures contain a great excess. Also it has been shown that preparations such as protein milk, which should contain a relatively small amount of salt, may contain a large amount, a fact that may explain its unfavorable action in some cases of diarrhea.

CONCLUSIONS

1. The sodium chlorid content of cows' and goats' milk varies greatly. This variation in the case of cows' milk may be 140 per cent.—in the case of goats' milk, 20 per cent.

2. The variation in the sodium chlorid concentration of cows' and goats' milk is not due to differences in the "salt" intake.

3. The sodium chlorid content of cows' and goats' milk is dependent, in part, on the volume of milk that is secreted. Animals that give a large amount of milk tend to have lower percentages of sodium chlorid, and those that give small amounts of milk have higher percentages.

4. The sodium chlorid content of formulas that are commonly used in infant feeding varies greatly, and, in general, is much in excess of that found in human milk.

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3. Forbes, E. B.: Ohio Agric. Exper. Station Bull. 295, 1916; ibid. 308, 1917.
4. Denis, W., and Sisson, W. R.: J. Biol. Chem. **44**:483 (May) 1921.

5. The sodium chlorid content of formulas made of whole milk and of cream and skimmed milk more nearly approaches that of human milk, while the chlorin content of formulas made from whey generally exceeds that found normally in human milk by 200 per cent.

6. The sodium chlorid content of "protein milk" frequently varies greatly.

CLINICAL DEPARTMENT

RESPIRATORY OBSTRUCTION RESULTING IN DEATH

CASE REPORT WITH NECROPSY FINDINGS *

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History.—J. McC, a white boy, aged 4 months, whose family history was negative, had had rhinitis two or three times. He was breast fed for three months, then he was fed on whole milk mixtures until his death. He did not have any gastro-intestinal disturbances. He was a first born child. The labor had been normal. His present illness dated from the day after his birth when his mother noticed that his breathing was more noisy than normal. He was not cyanotic and did not seem to be in distress. This noisy breathing became more and more pronounced. He had been cyanotic only once, for about five minutes, when he seemed to strangle. His appetite was good. Breathing was always more difficult after a meal or when crying.

Physical Examination.—This showed a malnourished, white, male infant, lying quietly in bed; no distress; sensorium clear; skin rather dry and hanging loosely so that it can be picked up in folds. Tissue turgor is poor. There is no enlargement of lymph nodes; no cyanosis.

Head: Anterior fontanel is of normal size, soft and pulsating; posterior fontanel is closed. Sutures are normal. Eyes: Pupils react to light; conjunctivae are pale; sclerae clear. Nasal passages are clear. Mouth: Tongue rather dry; gums and buccal mucous membrane are normal. No abnormality of the pharynx can be seen or felt. Laryngoscopic examination was not made. Ears are normal.

Chest: Well formed; not at all "barrel-shaped;" no abnormality of bony structure. Both inspiration and expiration are labored and noisy; no difference in duration of the two. On inspiration the accessory muscles of respiration are used to their full extent and the ensiform is greatly depressed. There is a loud inspiratory and expiratory stridor. This stridor is present at all times, but is much more pronounced for from one-half to one hour after feeding or when the child is crying. There is no cough.

Lungs: Percussion is normal, except over the vertebrae where dulness extends to the sixth dorsal vertebra. Breath sounds are normal, except over the area of dulness in the back, where they are harsh. No râles heard anywhere.

Heart: Normal to percussion and auscultation.

Abdomen: Soft and tympanitic throughout; no masses or tenderness. Liver is palpated 2 cm. below the costal margin in the mammary line. Spleen is not palpable. Genitalia: Normal. Extremities: Muscles wasted; little or no subcutaneous fat. Reflexes: Normal.

Roentgenograms of chest, taken at intervals of about two weeks, show no abnormality.

Pirquet Test: Twice negative. Wassermann Test: Negative.

Diagnosis.—Enlarged thymus.

Treatment.—The baby was given roentgen-ray applications at one week intervals for four weeks. For forty-eight hours after each treatment his con-

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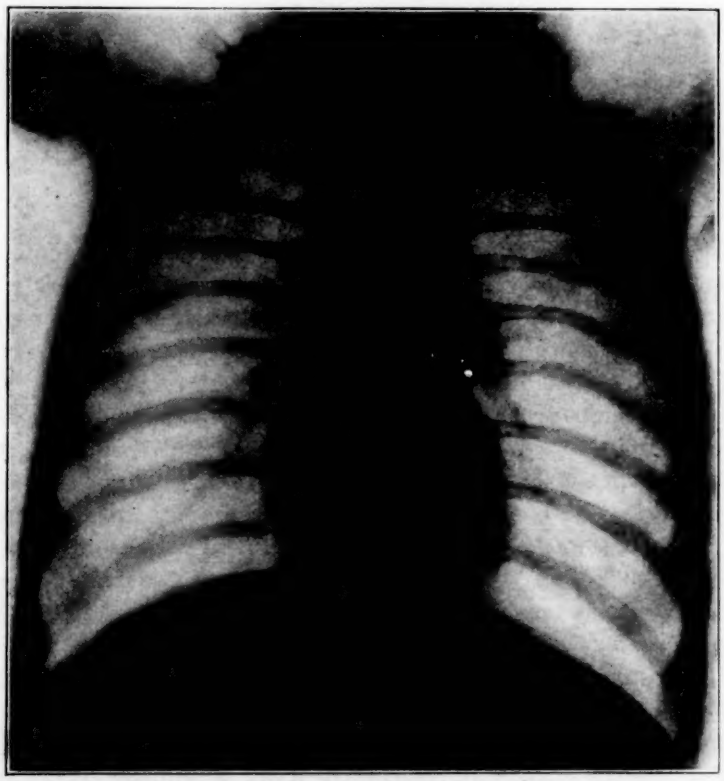
* From the Departments of Pediatrics and Pathology of the University of Louisville Medical School.

dition was decidedly worse, the stridor being more pronounced and the breathing more difficult, and he was slightly cyanotic. He then returned to his previous condition. He was not benefited by the roentgen-ray treatment.

The baby was fed on a 10 to 20 whole milk mixture, 5 ounces, six feedings, made up to 6 per cent. sugar with Karo corn syrup. He never had any gastrointestinal disturbance. At times he had great difficulty in swallowing his food and had to be fed with a stomach tube. The first time a stomach tube was used (No. 22 soft rubber catheter) the respirations were completely blocked and no air could pass in or out. He became cyanotic and the tube had to be withdrawn immediately. Later a smaller tube (No. 15) was used, and while it always increased the dyspnea it was possible to feed the patient in this way. The stridor was present at all times and was both inspiratory



Roentgenogram of chest with negative findings.

and expiratory. It was much worse when he was excited or after being fed, and at these times the stridor could easily be heard 75 feet away.

About one week before his death the respiratory difficulty became worse. He was now slightly cyanotic all the time. As he was more comfortable in a semirecumbent posture, he was kept propped up in this position night and day. Each feeding was an ordeal. He could not swallow the milk without aspirating some of it and having a violent coughing spell. When the small catheter was passed into his stomach, the respirations were dangerously obstructed. About forty-eight hours before his death a roentgen-ray treatment was given and shortly after this, his symptoms became greatly exaggerated and continued so until his death.

REPORT OF NECROPSY (DR. GRAVES)

Necropsy six hours after death. Body length, 63 cm. Age, 4½ months. Body is that of fairly developed, poorly nourished, white, male child. Moderate postmortem lividity in dependent portions. Rigor mortis and edema absent. Pupils equal, regular, 3 mm. in diameter. Teeth not erupted. Anterior fontanel not closed. Skin wrinkled and pale with very little subcutaneous tissue. Bones prominent and spaces sunken everywhere. Axillary glands barely palpable. The peritoneal, pericardial and pleural cavities are normal. All organs are normal. The posterior portions of the lungs are congested. The genital organs are infantile.

The thymus in situ is 50 mm. long and 35 mm. wide. Its upper portion lies 10 mm. above the sternoclavicular joint. It is roughly triangular shaped and is not remarkable except that the larger portion lies cephalic and just underneath the upper portion of the sternum in the bony inlet. Weight, 3 gm. (correct weight).

The necropsy revealed nothing remarkable except malnutrition and the unusual shape and location of the thymus. As compared with the appearance in other children examined postmortem previously and subsequently, the thymus appeared to be higher than usual and presented the larger extremity cephalad instead of caudad.

DISCUSSION

(Dr. Bruce)

The history of stridor, beginning soon after birth and continuing uninterruptedly until death, would rule out any cause which would produce spasm of the laryngeal muscles, such as spasmophilia or croup. These conditions are practically never seen in infants of this age.

There is a great deal in this case to suggest congenital laryngeal stridor; i. e., it was noticed soon after birth and continued unabated until the end. However, there are points which make this diagnosis impossible. In the first place, death in these cases is, so far as I know, always caused by intercurrent disease or respiratory infection, which was not present in the case under discussion. In the second place, the stridor of congenital laryngeal stridor is always inspiratory, whereas the stridor in this case was both inspiratory and expiratory and if anything expiration was a little louder than inspiration.

The postmortem appearance of the larynx was normal and there certainly was no malformation present.

From the positive D'Espine sign, I had expected to find tuberculous glands about the hilus or an enlarged thymus. There were no enlarged or tuberculous glands. The shape and position of the thymus are worthy of consideration. It was roughly diamond shaped and its greatest diameter lay in the bony thoracic inlet. The diameter of the inlet was not measured, but it takes a very small object to block it up and occlude the structures that pass through it. It seems to me that the fact that, when a No. 22 soft rubber catheter was passed through the esophagus into the stomach it completely occluded respiration, is evidence that the trouble lay in the superior thoracic inlet, as this is the only point at which the esophagus and trachea pass through an inflexible

medium. I have passed a No. 22 catheter on many other babies of the same age and never observed respiratory distress in any other case. It seems logical to believe, therefore, that even a 3 gm. thymus, if located in this narrow aperture, could cause tracheal obstruction. While it is impossible to state definitely that this was the cause of death, I think it is the most likely explanation of the case.

PROGRESS IN PEDIATRICS

A REVIEW OF THE LITERATURE OF SYPHILIS IN INFANCY AND CHILDHOOD*

PARK J. WHITE, M.D.
ST. LOUIS

Jeans [1] has reviewed the literature on this subject up to April, 1920. It is the object of the present review to bring the literature to date (December, 1921). A brief survey suffices to show the extent to which contributions from the laboratory predominate over those from clinic and practice. The reason for this is not far to seek. Syphilis, hereditary or acquired, is a disease in whose investigation and partial conquest the laboratory has played an important, an essential part. Excepting statistical reports, there are relatively few clinical observations or contributions to symptomatology. Clearly, serology, chemistry and pathology offer the widest fields for original endeavor in this disease.

INCIDENCE

Jeans and Cooke [2] made a study of the placentas, and of the Wassermann reactions of the cord blood of a series of 2,030 unselected infants in St. Louis. By examining the blood of 389 of these infants after 2 months of age, it was determined that the proportion of cases of hereditary syphilis that could be diagnosed with certainty by placental examination alone was 27 per cent. From the Wassermann reaction on the cord blood, 63.6 per cent. could be recognized. By applying these two methods to the series, the number of cases of hereditary syphilis in the entire group was determined to be 15 per cent. in the colored race, 1.8 per cent. in the poor of the white race, and less than 1 per cent. in the well-to-do classes. The incidence of hereditary syphilis at birth for all classes in St. Louis is 3 per cent., of which the colored population, although only 9 per cent. of the total, contributes approximately half the cases. In a somewhat similar study, Ross and Wright [3] found 3.5 per cent. of the specimens of (placental) blood to be positive.

In evaluating such statistical reports, two very important factors to bear in mind are the race and the standard of living of the people

* From the Department of Pediatrics, Washington University.

1. Jeans: Am. J. Dis. Child. **20**:55 and 132 (July and Aug.) 1920.
2. Jeans and Cooke: Am. J. Dis. Child. **22**:402 (Oct.) 1921.
3. Ross and Wright: Lancet **1**:321 (Feb. 12) 1921.

studied. Burhans' figure [4] of 1.5 per cent. (for the Babies' Dispensary and Hospital of Cleveland), is rather unusually low for clinic patients. Royster's figure [5] of 12.5 per cent. (for a clinic in Norfolk, Va.) is decidedly high, and may be explained by the large proportion of colored patients in the clientele. The incidence of 3 per cent. for St. Louis, and 3.5 per cent. (Ross and Wright) for an English mining and industrial town, are in fairly close agreement and are based on the entire population of each town.

RELATION OF SYPHILIS TO INFANT MORTALITY

In any consideration of deaths due to syphilis, fetal mortality assumes first place. Morgan,[6] for example, estimates that 2,000 miscarriages and stillbirths occurred in the city of Toronto in 1920, and that 30 per cent. of these were due to syphilis—thus making 670 an index of the prenatal ravages of syphilis in that city in one year. Solomon and Solomon,[7] in a complete study of 555 families of late syphilitics, state that 29.7 per cent. gave birth to no living children, 23 per cent. being entirely sterile, 6.7 per cent. having unsuccessful pregnancies. The 29.7 per cent. of childless syphilitics should be contrasted with 11.3 per cent. childless in a similar census group. The average birth rate per family was 2.05, and the average number of living children per family was 1.62. In the same type of population taken at random, the average birth rate per family was 3.8. How large a part syphilis plays in race suicide is thus obvious.

Williams [8] studied 302 fetal deaths (99 white, 203 black) in 4,000 deliveries. Syphilis was responsible for 34.4 per cent. of the deaths—being the most important single cause. Allowance must, of course, be made for the fact that colored people comprised more than half the clinical material reported. The high figures for syphilis given by Williams may well be compared with those given by Meyer,[9] who, in the course of a detailed discussion of abortion, says: "Associated constitutional or venereal diseases were recorded in only seventy-six out of 697 selected histories. In fifty-two of these, other causes for the termination of the pregnancy were also recorded." Hornung's [10] figures for 221 pregnant syphilitic women in Kiel are also lower than those of Williams.

Two instructive contributions to the subject of stillbirth, giving more of its pathologic aspects, are those of F. J. Browne. In the

4. Burhans: Ohio State M. J. **17**:821 (Dec. 1) 1921.
5. Royster: Am. J. Syphilis **5**:131 (Jan.) 1921.
6. Morgan: Canad. M. A. J. **11**:849 (Nov.) 1921.
7. Solomon and Solomon: Social Hygiene **6**:469 (Oct.) 1920.
8. Williams: Bull. Johns Hopkins Hosp. **31**:141 (May) 1920.
9. Meyer: Am. J. Obst. & Gynec. **2**:138 (Aug.) 1921.
10. Hornung: Zentralbl. f. Gynäk. **44**:1222 (Oct. 23) 1920.

first [11] he reports a pathologic study of 200 consecutive cases of stillbirth and neonatal death in the Edinburgh Royal Maternity Hospital. Twenty-two macerated fetuses are included in the series. In fourteen of these cases syphilis was the cause of fetal death. Besides the fourteen macerated fetuses there were twenty-one other cases of syphilis. Twenty-six of the total of thirty-five cases were premature. The pathologic findings reported in this and in his later articles will be discussed under pathology. Further statistics from necropsy material are those of Warwick,[12] who found 9.5 per cent. of deaths due to syphilis in 200 necropsies performed on babies who were stillborn or who died a week after birth (in the city of St. Paul).

As reports of fetal and neonatal mortality due to syphilis vary to some extent with the factors affecting each series, so do the reports of infant mortality from this cause. In the series of Solomon and Solomon,[7] the infant mortality rate was 124 per thousand. This is less than the rate given in Massachusetts census for 1910 (i. e., 131 per thousand). Thus, in a series of children of late syphilitics, the infant mortality rate and the deaths of children under 18 do not vary greatly from the mortality as found in the community. The authors remark that the percentage of living nonsyphilitic children is considerably greater in this study than in the studies of many other investigators, due, no doubt, to unconscious selection in other studies. It is noteworthy, however, that only 30.3 per cent. of the entire group were free from defect as to children and syphilis in the spouse.

The difficulties encountered in obtaining accurate figures on infant mortality from syphilis are well described by Morgan.[6] He found that in one year, in the city of Toronto, only nineteen certificates mentioned hereditary syphilis as a cause of death. He mentions the physicians' fear to record syphilis "to be hawked about among relatives for the delectation of prudes." This factor of concealment is no doubt often an important one. It must be borne in mind, however, as will be seen later, that often the pathologist himself is unable definitely to prove that in a given case hereditary syphilis was actually the cause of death. Athrepsia, bronchopneumonia, etc., are such frequent "terminating complications" that it is easy, though, of course, misleading, to record any of these without mentioning the underlying syphilis.

Morgan reports that of 725 successive admissions to the medical wards of the Toronto Hospital for Sick Children, twenty-nine were syphilitic—or 4 per cent. He considers that for the whole population the figure must be considerably higher. According to this writer, 90 per cent. of deaths from syphilis occur during the first year. Burhans [4] found that the known mortality for 141 cases was forty-nine, or 34.7

11. Browne, F. J.: Brit. M. J. **2**:140 (July 30) 1921.
12. Warwick: Am. J. Dis. Child. **21**:488 (May) 1921.

per cent. In fifteen of these the cause of death was given as hereditary syphilis. Kaufmann-Wolf and Abrahamson [13] report their fifth series of this kind. The total mortality for the five series was at least 70 per cent. when the mother was infected; and under all conditions, it was about 50 per cent. The morbidity of the living averaged 50 per cent., so that only 25 per cent. of children in the 134 families grew up healthy.

In his valuable report of the first year's work of a clinic for syphilitic children, Jewesbury [14] presents the findings in 145 children whose mothers were known to be syphilitic. Of these, nine mothers became infected after the children were born—hence the disease in the children was acquired. Of the remaining 136 mothers, forty-seven had treatment during pregnancy or before. In about 50 per cent. of the cases, the disease was most marked in the early pregnancies, and apparently became gradually attenuated. But in just as many cases, children free from infection appeared in the midst of syphilitic children and miscarriages.

HEREDITARY TRANSMISSION

To gain a complete understanding of the manner of transmission of hereditary syphilis, one should study in order the "vivo and vitro" characteristics of the *Spirochaeta pallida,* its effects on the father, the mother and, through them, on their children. A sufficiently thorough consideration of all the recent literature on the spirochete would consume too much space. Some of the work done, however, requires mention—notably the experiments with rabbits by Brown and Pearce. Their results on the dissemination of spirochetes,[15] the lesions of the skin,[16] mucous membranes,[17] eyes,[18] etc., are of much value, though without immediate bearing on the transmission of syphilis to children. Their studies on latent syphilis throw some light on the important question of how a father suffering from this form of the disease may still be capable of transmitting it to his wife and thus indirectly to the offspring. Material from the popliteal nodes of six rabbits, taken after considerable period of supposed recovery, or latency, was reinoculated into other rabbits. In each case active syphilis resulted. The authors conclude that recovered rabbits may harbor virulent spirochetes almost indefinitely, even without further manifestations of activity. The lymphoid tissues of the body are probably the chief reservoirs of the virus during latent periods. Frühwald,[19] reporting

13. Kaufmann-Wolf and Abrahamson: Ztschr. f. klin. Med. **89**:274, 1920.
14. Jewesbury: Lancet **1**:962 (May 7) 1921.
15. Brown and Pearce: Arch. Dermat & Syph. **2**:470 (Oct.) 1920.
16. Brown and Pearce: J. Exper. M. **32**:445 (Oct.) 1920.
17. Brown and Pearce: J. Exper. M. **32**:447 (Nov.) 1920.
18. Brown and Pearce: J. Exper. M. **34**:167 (Aug.) 1921.
19. Frühwald: Wien. klin. Wchnschr. **33**:999 (Nov. 11) 1920.

eighty-nine gland punctures in eighty-three (acquired) syphilitics, found that as the secondary stage progresses spirochetes in the glands become rarer, but that the glands may shelter them up to the third year. In four cases, latent after the conclusion of treatment, spirochetes were demonstrated in three of fourteen gland punctures.

In an experimental study of the latent syphilitic as a carrier, Eberson and Engman [20] isolated the spirochete from five cases out of seventy-five, ranging in latency from one to forty years after the disappearance of syphilitic signs and symptoms. Three times the organism was found in inguinal glands (in two women and one man) and twice in semen. The strains produced typical syphilitic lesions in rabbits' testicles. *Spirochaeta pallida* was isolated from patients who gave a history of syphilis dating back eleven and thirteen years, respectively, in two instances, and one year in three instances. An inguinal gland and the semen proved positive for spirochetes in the two cases first mentioned, and the glands and semen in the last named case. The blood and other body fluids, except semen, are not infectious in latent syphilis, or if so, but rarely. These facts are clearly important from the point of view of hereditary syphilis, the persistent positivity of the semen for spirochetes even after treatment or a long period of latency, indicating the difficulties in the way of protecting the prospective mother from infection by the father.

In explanation of some of the vagaries of the spirochetes, the interesting theory has been advanced that the organism passes through an intermediary or "resting" stage like that of the protozoal parasites. One of the strongest arguments in favor of the theory has been that spirochetes have never been recovered or seen during the incubation period within the rabbit's testis. According to Eberson,[21] the absence of organisms, as judged solely by microscopic findings, is not convincing proof that a change of form has taken place within the animal body. That the *Spirochaeta pallida* is found unaltered both in morphology and in virulence in the blood and glands, seems to him sufficient to render the "resting stage" theory untenable.

If the physical obstacles to protection against infection by the husband are great, the social obstacles are still greater. Peter,[22] for example, has followed 1,000 patients who had been under treatment for venereal disease at free dispensaries, and draws a gloomy picture of the heedlessness and lack of perseverance of the great majority. Roberts [23] has had the same experience. He found that severity of symptoms at

20. Eberson and Engman: J. A. M. A. **76**:160 (Jan. 15) 1921.
21 Eberson: Arch. Dermat. & Syph. **3**:111 (Feb.) 1921.
22. Peter: Schweiz. méd. Wchnschr. **50**:623 (July 15) 1920; abstr. J. A. M. A. **75**:773 (Sept. 11) 1920.
23. Roberts: Lancet **2**:277 (Aug. 6) 1921.

onset had very little influence on attendance. (This factor is more important in hereditary cases in which symptoms are more likely to be alarming.) The most important factor in relation to attendance was the positivity or negativity of the Wassermann reaction. Patients (and this applies to parents, of course) must be instructed repeatedly that a negative Wassermann reaction does not mean a cure. Letter cards are an important though often unsuccessful means of getting patients to return. It is noteworthy that in Robert's series, 8.2 per cent. gave the wrong address when registering. Persons persisting in treatment until clinical and serologic cure has been affected are not protected against reinfection. Though such reinfection undoubtedly occurs, it is no evidence of curability; and these two conceptions, according to L. Jacobi,[24] should be dissociated.

Widakowich [25] gives an extensive bibliography, together with sixty-four illustrations of anomalous forms of spermatozoa in syphilitics. The percentage of pathologic forms was much higher in syphilitic than in normal men, and in heredosyphilitics than in patients with the acquired disease. Sidler-Huguenin [26] states that the male sexual organs are injured more than the female by inherited syphilis, judging from the smaller number of children in the families where the syphilitic is the father. He was unable to find symptoms of syphilis in the sixty-five children of the second generation, except in one doubtful case. He believes that persons with inherited syphilis can be assured that their children will not feel the effects of it, that is, of course, if they have any children, which they often do not.

Solomon and Solomon [7] found, as they expected, a higher incidence of positive Wassermann reactions in mates than in offspring. Thirty per cent. of the spouses were positive. From 8.4 to 16.7 per cent. of the children (depending on the method of selection) were positive. Nearly one fifth of the mothers of syphilitic children gave a negative Wassermann reaction and were without symptomatic evidence of syphilis.

Riecke and Hoernicke [27] cite, among others, a family in which the grandfather had tabes. His daughter and her son were syphilitic. The usual difficulty of absolutely ruling out acquired syphilis in the mother was encountered. Bruusgaard [28] reports the fifth thoroughly studied case of hereditary syphilis in the second generation at the Christiania Hospital. The grandmother is being treated for a gummatous tertiary

24. Jacobi, L.: Arch. Dermat. & Syph. **2**:493, 1920.
25. Widakowich: Semana méd. **27**:633 (Nov. 11) 1920; abstr. J. A. M. A. **76**:414 (Feb. 5) 1921.
26. Sidler Huguenin: Schweiz. med. Wchnschr. **51**:49 (Jan. 20) 1921.
27. Riecke and Hoernicke: München. med. Wchnschr. **68**:1 (Jan. 7) 1921.
28. Bruusgaard: Norsk Mag. f. Lægevidensk. **82**:353 (May) 1921; abstr J. A. M. A. **76**:1803 (June 18) 1921.

periostitis, the mother for periostitis of both tibias, and the boy, aged 8, has fan-shaped deep scars extending from the corners of the mouth. He has a two-plus Wassermann reaction. The mother during pregnancy had tertiary ulcerations and keratitis. Another family history of interest is that given by Bernheim-Carrer.[29] From his records, however, and from the literature in general, it would seem that definite proof of the hereditary transmission of syphilis from one generation through the two succeeding is still lacking.

The maternal, or, more accurately, the placental transmission of syphilis to offspring, is an accepted fact. Diagnosis is much more difficult in women than in men, owing to the frequent absence of symptoms. Swayne[30] believes that a very large number of women contract the disease innocently; and that they are more likely than men to act as innocent carriers. This author makes the general observation that syphilitic symptoms and early lesions are not so virulent now as they were many years ago; and credits the possibility that tabes and paresis are more frequent (an observation questioned by McKenna.)

Data obtained by Fischl and Steinert[31] confirm the placental transmission of syphilis, and also, unexpectedly, confirm Profeta's law, to the extent that seventeen apparently healthy infants failed to show any sign of syphilis, although their mothers were in the most contagious phase of florid syphilis. Ten of the infants in this group never had a positive Wassermann reaction. Five of the mothers were also constantly negative, notwithstanding their florid papules at the anus, etc. Immunization by way of the placenta before birth and by suckling afterward will have to be accepted in these cases, according to the authors, even allowing for the defective production (common to the new-born) of substances yielding the Wassermann reaction. They report several infants with pronounced lesions swarming with spirochetes, but with a constantly or frequently negative Wassermann reaction. Treatment with arsphenamin did not display any provocative action in this respect. In thirty-four infants the manifestations of inherited syphilis developed late, and the Wassermann did not become positive until some time later, but in 11.7 per cent. the Wassermann veered to positive as the precursor of the clinical manifestations.

Experimental work has shown[32] that the reaction of rabbits to genital inoculations of spirochetes at the time of conception differs markedly from that of normal animals. This difference extends through the period of pregnancy and well into the period of lactation. The defensive mechanism of pregnant animals is capable of opposing

29. Bernheim-Carrer: Monatschr. f. Kinderh. **21**:130 (May) 1921.
30. Swayne: Brit. M. J. **2**:476 (Sept. 24) 1921.
31. Fischl and Steinert: Arch. f. Kinderh. **69**:309 (June 21) 1921; abstr. J. A. M. A. **77**:581 (Aug. 13) 1921.
32. Brown and Pearce: Am. J. Syphilis **4**:593 (Oct.) 1920.

a resistance to inoculations at the time of conception, such that little or no clinical sign of infection appears.

In inherited syphilis the placenta is likely to be exceptionally large in proportion to the size of the fetus.[33] Intense local phagocytosis explains the rarity of the discovery of spirochetes in the placenta.[34] All of the organisms may be incorporated in phagocytes in the blood stream or in the endothelial cells of the capillaries, even when the viscera of the fetus may be swarming with spirochetes.

McWalter[35] reports a case to show that infection of a mother with syphilis in the eighth month of her pregnancy results in infection of the child. The syphilis in the child is of milder form, and develops later than ordinary hereditary syphilis. Gellhorn[36] deplores the tendency to regard maternal syphilis as unimportant, except as it affects the fetus, and contends that it is capable of producing real obstetrical complications.

THE QUESTION OF DIFFERENT STRAINS OF THE SPIROCHETE

Whether or not there are special strains of the spirochete responsible for the various clinical forms of syphilis is a question which has given rise to considerable discussion. Many of the arguments pro and con are based on hereditary transmission. Gougerot[37] gives an interesting review of the subject. The "pluralistes" support their contention with the fact that cases are on record of men contaminated by the same person, all having syphilis of the central nervous system. They also emphasize the occurrence of conjugal neurosyphilis; the absence of cutaneous lesions in cases of syphilis of the central nervous system; the fact that natives of the tropics seldom have syphilis of the central nervous system; the different degrees of contagiousness; "distinct evolution." The "unicistes" dispute most of these claims, and emphasize the individual differences of the various hosts.

Levaditi and Marie[38] give experimental evidence in favor of two types of spirochetes: the neurotropic type on the one hand, and the skin and mucous membrane type on the other. They point to the fact that rabbits inoculated with one type are not protected against the other, and that the course of the infection differs notably according to the type inoculated.

In their article on conjugal neurosyphilis, Moore and Keidel[39] note that the clinical evidence favoring the existence of a neurotropic strain lies partly in the comparative frequency of neurosyphilis in both

33. Lévy-Solal: Gynéc. et Obst. **4**:94 (Aug.) 1921.
34. Manouélian: Gynéc. et Obst. **3**:1 (Jan.) 1921.
35. McWalter: Brit. M. J. **1**:827 (June 19) 1920.
36. Gellhorn: Surg. Gynec. & Obst. **32**:535 (June) 1921.
37. Gougerot: La Médecine **2**:85 (Nov.) 1920.
38. Levaditi and Marie: Presse méd. **28**:646 (Sept. 15) 1920.
39. Moore and Keidel: J. A. M. A. **77**:1 (July 2) 1921.

partners to a marriage and in their children. They present the results of examination of forty-two wives, two mistresses, and eight husbands, being the marital partners of fifty known neurosyphilitic patients. Forty of the partners were syphilitic, and 33 per cent. of these had neurosyphilis. Though there is a high incidence of conjugal neurosyphilis in the partners of parenchymatous neurosyphilitics, the comparatively low percentage found in the partners of cerebrospinal neurosyphilitics somewhat lessens the strength of this argument for duality of strain. Feldman [40] reports a family in which the father had taboparesis with paraplegia, the mother and the oldest boy had tabes, and a younger boy had cerebrospinal syphilis with paraplegia. The first clinical symptom in each case was nystagmus. Another boy in the same family died of cerebrosyphilis. The (blood) Wassermann reaction was positive in all. The author recalls another family in which there was no neurosyphilis, though all were syphilitic. He favors the "special strain" theory, mentioning that the hereditary transmission of a poorly resisting central nervous system is hardly logical, since inherited traits cannot be transmitted from husband to wife.

Solomon and Solomon [7] found in their series very little difference in the various percentages obtained in families of patients with general paresis and those without central nervous involvement. The problems of syphilis are practically the same from the familial point of view, whatever course the syphilis takes in the individual patient. They add that in the past numerous articles have been written to show that the offspring of paretics were remarkably healthy and quite devoid of familial syphilis. Parallel studies indicate the contrary.

Thom [41] is convinced that there is no such thing as different strains in spirochetes. The selective action of spirochetes in the body is governed entirely by the manner in which the tissues of the host react. Hutinel [42] maintains that there is one type of hereditary syphilis in which specific dystrophic changes are produced by the spirochete or its reactions, and another in which nutritional disorders are found. The endocrine glands are the tissues principally attacked. The children of such patients may also have hereditary dystrophies. Audrain [43] presents the tabulated details of thirty families, through three or four generations from a progenitor with unsuspected syphilis. He finds that the law of persistent localization of the lesions is confirmed, also their periodicity and the rarity of pain.

Gordon [44] cites cases of conjugal tabes and paresis from the literature, and notes reports to the effect that either partner may develop

40. Feldman: Med. Rec. **100**:1107 (Dec. 24) 1921.
41. Thom: Am. J. Syphilis **5**:9 (Jan.) 1921.
42. Hutinel, P.: Arch. d. med. d. enf. **23**:5, 145, 205 (Jan.-April) 1920.
43. Audrain: Bull. Soc. de derm. et de syph. p. 85 (Feb. 10) 1921.
44. Gordon: Am. J. Syphilis **5**:248 (April) 1921.

the form of neurosyphilis from which the other has been suffering, perhaps, for years. Considerable laboratory work—particularly, of course, with the cerebrospinal fluid—is required to put familial neurosyphilis on a scientific basis. Cestan, Riser, and Stillmunkés [45] have contributed to this phase of the subject in an article in which the "colloidal benzoin" reaction of the spinal fluid is discussed.

THE WASSERMANN REACTION

Since April, 1920, the literature on this subject has been abundant —one might say, lavish. The technic, or rather the technics, of the test as employed by various observers cannot be discussed here. Studies of the test as applied to syphilitic children and their families are, of course, mostly statistical. In an analysis of 4,000 Wassermann tests on pregnant women, Williams [46] found 449 positive (11.2 per cent.). Forty-three women (1 per cent.) with negative Wassermann reactions, had syphilitic children. The author believes that the evidence shows that less than half (40 per cent.) of the positive mothers will have syphilitic children. A syphilitic placenta does not inevitably mean that the child will have the disease. It will be recalled that Jeans and Cooke [2] found that only 27 per cent. of cases of hereditary syphilis could be diagnosed by placental examination alone, and that 63 per cent. of the cases could be recognized by the Wassermann test on the cord blood. Williams found that a positive fetal blood Wassermann was associated with a syphilitic infant in 76 per cent. of cases. His results with the Wassermann test lead him to conclude that both paternal infection of the fetus and Colles' law have neither been proved nor disproved. Having seen families in which the father has a positive Wassermann reaction and the mother a negative one, he is not as skeptical about Colles' law as are many other observers.

In a somewhat similar Wassermann study, Nobécourt and Bonnet [47] found that in pregnant women there were more positives in the seventh than in the fourth, fifth and sixth months. There was agreement between the blood of the mother and that of the baby in 90 per cent. of the cases. The majority of discrepancies were the positive—mother-negative-child reactions—which the authors attribute to postconceptional syphilis.

Goodman [48] found that in a series of 1,320 pregnant women, 87 per cent. were Wassermann negative. Of the Wassermann negative multiparas, 37 per cent. had suffered one or more miscarriages, as

45. Cestan, Riser, and Stillmunkés: Bull. de l'Acad. de méd., Par. **86**:116 (July 26) 1921.
46. Williams: Bull. Johns Hopkins Hosp. **31**:336 (Oct.) 1920.
47. Nobécourt and Bonnet: Presse méd. **28**:745, 1920.
48. Goodman: Surg. Gynec. and Obst. **30**:368, 1920.

compared with 52 per cent. of the four plus cases. Only one woman of the entire series gave a history of having been known to be infected with syphilis.

It is becoming increasingly clear that the interpretation of the Wassermann reaction, and the recording of the degree of positivity are two factors which should not be overlooked in evaluating the results of Wassermann surveys. Yet in many such surveys they are not considered. The importance of attaching proper significance to the Wassermann report is emphasized by Heagerty.[49] Quoting the All-American Conference on Venereal Diseases (December 1920): "A frank, reliable, positive Wassermann reaction should be regarded as a sign of syphilis. In the absence of all other evidences of syphilis, a diagnosis based on a positive Wassermann alone should be made with great caution, and the Wassermann report confirmed by repetition and examination in another laboratory. A negative Wassermann cannot be regarded as evidence of the absence of syphilis." Browne[50] draws practically the same conclusions.

Thaysen[51] discusses the cases in which a positive Wassermann reaction does not indicate active syphilis, and analyzes active syphilis from both the clinical and biologic points of view. He declares that notwithstanding the positive Wassermann reaction in the late latent stage, the syphilis may be regarded as inactive in a large proportion of cases. His article serves to show that the terms active, inactive, and latent, are capable of various interpretations, and that such interpretations are of considerable importance to the patient from the therapeutic point of view.

The necessity for understanding the limitations of the Wassermann test is emphasized by Rohdenburg.[52] Three important influencing factors are named: (1) The patient. Fever and other conditions, such as recent ingestion of alcohol may give a falsely positive result. Treatment should be discontinued for at least eight weeks before a negative report is accepted. (2) The collection of the specimen. (3) The technic of the test. In 148 cases with Wassermann reaction negative for three years following treatment, the reaction again became positive in five patients. (Spinal puncture was not reported in these cases.) The late quiet cases of hereditary syphilis (six in number) have never had even a temporarily negative reaction in spite of enormous dosage and long treatment. (They apparently had no examination of the spinal fluid.)

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49. Heagerty: Canad. M. A. J. **11**:548 (Aug.) 1921.
50. Browne, F. J.: Edinburgh M. J. **27**:199 (Oct.) 1921.
51. Thaysen: Ugesk. f. Laeger **83**:759 (June 9) 1921; abstr. J. A. M. A. **77**:658 (Aug. 20) 1921.
52. Rohdenburg, Garbat, Spiegel and Manheims: J. A. M. A. **76**:14 (Jan. 1) 1921.

Discussing the various factors responsible for the positivity of the Wassermann test, Wassermann himself says [53] that not only protein substances, but also lipoids may produce genuine antibodies (an observation appearing more and more frequently in the literature on anaphylaxis). The syphilitic suffers from an inversion of lipoid metabolism, which explains why the Wassermann reaction is positive not only with the extracts from organs of all stillborn syphilitic children, but also with all extracts containing lipoid-like substances. Epstein and Paul [54] emphasize that colloidal, electric, and surface tension reactions are involved, not changes in the chemical structure of the reacting substances.

With regard to the limitations of the Wassermann reaction in hereditary syphilis, Rolleston [55] states that a positive reaction at birth is not certain evidence of syphilis, for (McIntosh and Fildes) the reacting substance may pass from mother to child in utero. The Wassermann reaction may be negative for weeks after birth, then positive. It tends to become negative about the time of puberty; and the disappearance of a positive Wassermann does not mean the absence of spirochetes. Various organs, especially the glands of internal secretion, may become involved, and the syphilis then become inactive, the symptoms being only those of involvement of such organs. If such cases are known to be syphilitic, negativity of the Wassermann does not mean that treatment is unnecessary. Quoting the work of Jeans,[56] the author adds his own experience to show the importance of testing the spinal fluid in cases of hereditary syphilis.

Cooke [57] reports 1,855 complement fixation tests for tuberculosis on 1,556 children. He makes the important observation that nonspecific fixation reactions were found in two conditions, hereditary syphilis and diphtheria. Of seventy-five hereditary syphilitics, with strongly positive Wassermann tests, twenty-one, or nearly a third, gave positive fixation tests for tuberculosis. None of the twenty-one had any demonstrable evidence of tuberculosis, though some of the older children had the usual positive Pirquet skin test. The author considers it likely that in children with a high concentration of syphilitic antibodies in the blood, the tubercle antigen has an action similar to the other nonspecific lipoid antigens used in the Wassermann test. The antibodies giving the Wassermann reaction are usually present in considerably higher concentration in children with hereditary syphilis than in adults with the acquired form of the disease. None of the children under one

53. Wassermann: reported in Berlin Letter, J. A. M. A. **76**:463 (Feb. 12) 1921.
54. Epstein and Paul: Med. Klin. **17**:913 (July 24) 1921; abstr. J. A. M. A. **77**:1216 (Oct. 8) 1921.
55. Rolleston, H.: Lancet **1**:471 (March 5) 1921.
56. Jeans: Am. J. Dis. Child. **18**:173, 1919.
57. Cooke: Am. J. Dis. Child. **21**:78 (Jan.) 1921.

year reacted positively to the fixation test for tuberculosis. Similarly, infants with hereditary syphilis may not develop a positive Wassermann reaction for several months. The inability to form fixing antibodies may be associated with a lack of ability to form other protective antibodies.

Another condition requiring special interpretation of the Wassermann reaction, according to Henes,[58] is hypercholesterinemia. Pregnancy, jaundice and typhoid are three of the commonest causes of increased cholesterin content of the blood. In these conditions a strongly positive reaction should be somewhat discounted, a weakly positive one given but little weight. Conversely, in chronic nephritis and in the majority of pyrexias, the cholesterin content of the blood is diminished and corresponding allowance must be made for this in reading the Wassermann test.

To investigate the not uncommon phenomenon of so-called "Wassermann-fastness," Strickler [59] endeavored to determine whether or not some of the persistently positive reactions were due to arsphenamin treatment alone. Thirty patients with various skin diseases, whose histories and physical examinations were entirely negative for syphilis, whose first Wassermann tests were negative, were given weekly injections of arsphenamin. Only eight of the completely followed group of twenty-four remained consistently negative. Nine gave a 2 plus or greater degree of positivity, five were 1 plus, two were doubtful. As none of the patients was syphilitic, these researches could not be called experiments on the provocative Wassermann reaction. In explanation of these arsenic induced reactions, the authors suggest that the arsenic in some way acts on the liver alone or on the spleen and bone marrow also; that one or all of these organs may, as a result of the arsphenamin, elaborate a lipoid substance which may yield a positive Wassermann. Commenting on these observations, Kolmer [60] says that it is commonly believed that the serum of a syphilitic patient may give a negative Wassermann reaction if tested during or immediately after intravenous treatment. According to Strickler and his associates, just the reverse is to be expected. The observations of Strickler are not to be lightly dismissed, and should be held sub judice. At present Kolmer is unconvinced that arsphenamin produces such changes in nonsyphilitic individuals as would result in their serums yielding genuine positive Wassermann reactions.

A further study of Wassermann fastness is that of Stokes and Busman,[61] who found that in 458 treated patients, 22 per cent. of

58. Henes: Am. J. Syphilis **4**:685 (Oct.) 1920.
59. Strickler, Munson and Sidlick: J. A. M. A. **75**:1488 (Nov. 27) 1920.
60. Kolmer: Letter to J. A. M. A. **75**:1796 (Dec. 25) 1920.
61. Stokes and Busman: Am. J. M. Sc. **110**:658 (Nov.) 1920.

latent, late and hereditary cases remained persistently Wassermann positive. They found no evidence that Wassermann fastness is the result of any special strain. Persistent positivity seems to accompany grave, rather than mild syphilis.

There is a considerable amount of recent literature on the subject of diseases other than syphilis which give a positive Wassermann reaction. Touraine [62] names a number of tropical diseases in this class, mentioning leprosy as giving positive tests in 47 per cent. of cases—the tuberculous form even in 80 per cent.; pulmonary tuberculosis in 23.2 per cent.; lupus in 50 per cent. Prolonged ether or chloroform narcosis will give a positive Wassermann in 25 per cent. of cases. A number of blood diseases such as hemoglobulinuria, leukemia, etc., occasionally also contribute to the sources of possible error.

Recent evidence is against malaria as a cause of Wassermann positivity. Johnson [63] asserts that if a case is not clinically syphilitic, a positive Wassermann in any condition requires confirmation by repetition. In the various forms of malaria, the blood does not give a positive Wassermann reaction. Other causes must be operative. Iyengar [64] tested the serums of eighty-four cases of undoubted malaria in adults, and of fourteen cases in children. Seven gave a positive Wassermann. The author believes that malaria is not one of the causes of a positive reaction, and that quinin does not affect the reaction.

Studying fifty serums from patients suffering from typhus fever, Bauer [65] found that forty-six (92 per cent.) gave a positive Wassermann reaction, though none of them had any evidence of syphilis. The serums were taken during the fever period. He concludes that the Wassermann reaction is almost always positive in typhus fever when applied to inactivated serum, if the sample is taken before the crisis. He considers this of diagnostic value, since in many control cases of typhoid and paratyphoid solely negative results were secured.

Mason [66] reports two cases of diabetes mellitus, each with a strongly positive Wassermann reaction, neither having any history or symptom or sign of syphilis. Both patients were treated for their supposed syphilitic infection over a short period of time, with marked and rapid decline of their carbohydrate tolerance. The author thinks that probably the arsenic acted as a toxic agent on the weakened pancreatic cells, altering the quality or nature of their internal secretion.

It is noteworthy that Graves [67] found, in ninety controlled cases, flat discrepancies between antemortem and postmortem Wassermann reac-

62. Touraine: Rev. de méd. **37**:103, 1920.
63. Johnson: J. Path. and Bacteriol. **24**:145 (April) 1921.
64. Iyengar: Indian J. M. Res. **8**:136 (July) 1920.
65. Bauer: München. med. Wchnschr. **68**:1251 (Sept. 30) 1921.
66. Mason: Am. J. M. Sc. **162**:828 (Dec.) 1921.
67. Graves: J. A. M. A. **75**:592 (Aug. 28) 1920.

tions in only two. The postmortem Wassermann is practically as reliable as the antemortem if the serum is taken properly and if nothing unusual appears in the serum control tube.

There is persistent difference of opinion on the "provocative Wassermann reaction." Indications are that the test is losing favor. O'Leary [68] describes the method of performing the test which is used at the Mayo Clinic. Solomon and Klauder [69] found that after intravenous (or intraspinal) treatment the cerebrospinal fluid, negative before treatment, may become positive in all routine tests, or a weakly reacting fluid may become much stronger. This is compared with the Herxheimer reaction, or the production of neurorecurrences. Clinical improvement may result, and continued treatment may again produce a negative fluid.

Rusca's experience [70] with the Wassermann reaction in human milk shows that specific antibodies are present in breast milk, even in advanced lactation. The reaction is not as sensitive as that in the blood, but a positive reaction in breast milk is strong presumptive evidence in favor of grave and still active syphilis. Under specific treatment the reaction becomes negative in the milk before it disappears from the blood. Attempts at performing the Wassermann reaction on the urine have resulted unsatisfactorily on account of the frequency of anticomplementary reactions.[71]

FLOCCULATION REACTIONS IN SYPHILIS

In a review of this subject, Levinson [72] gives brief descriptions of six methods of performing flocculation tests on serum. He states that none of these has been found to be specific. The Bruck silver nitrate test, already reviewed by Jeans,[1] has also been found by Levinson to be unreliable. He quotes Vernes' [73] opinion that in order to produce flocculation with syphilitic serums and not with normal serums, an organic colloidal preparation, rather than a mineral suspension, is necessary. He discusses the Vernes phenomenon in some detail.

The Meinicke reaction, also discussed by Levinson, is based on the hypothesis that the reaction between serum and extract takes place when extract colloids disturb the isotonicity of salt solution permitting the union of seroglobulins and lipoid extract.

The Sachs-Georgi reaction [74] is a physicochemical reaction between seroglobulins and lipoid extract. The globulins in syphilitic serums

68. O'Leary: Arch. Dermat. & Syph. **2**:348 (Sept.) 1920.
69. Solomon and Klauder: Arch. Dermat. & Syph. **2**:679 (Dec.) 1920.
70. Rusca: Pedriatria **29**:121 (Feb. 1) 1921; abstr. J. A. M. A. **76**:968 (April 2) 1921.
71. Klauder and Kolmer: J. A. M. A. **76**:102 (Jan. 8) 1921.
72. Levinson: Am. J. Syphilis **5**:414 (July) 1921.
73. Vernes: Compt. rend. Acad. d. sc. **165**: 1917; 166, 167, 1918.
74. Sachs and Georgi: Reference given by Levinson.[71]

are increased in amount, and the flocculate which occurs in this reaction is a lipoglobulin aggregate. It is the simplest of all flocculation reactions. Levinson compared the Wassermann, Meinicke and Sachs-Georgi reactions, using animal serums known to give positive Wassermann reactions normally. His study gives the Sachs-Georgi reaction an advantage over the Meinicke reaction. None of the flocculation reactions can at present supplant the Wassermann test. The Sachs-Georgi reaction becomes positive earlier and remains positive longer than does the Wassermann reaction.

Epstein and Paul [75] performed the "third modification" of the Meinicke test on 1,100 serums. It proved as reliable as the Wassermann test, and, the authors believe, has a number of advantages over the latter. Gloor [76] found that the Sachs-Georgi reaction agreed with the Wassermann in a higher percentage of cases than did the Meinicke reaction.

A very large number of articles have appeared giving parallel statistics of the Sachs-Georgi and Wassermann tests.[77] Parker and Haigh [78] present many such statistics of other observers, together with data of their own. They conclude that the great simplicity of the Sachs-Georgi test, and its encouraging agreement with the Wassermann, make it worthy of further study. The consensus of opinion is well summarized by Logan,[79] when he says that unless the factors which may cause the false reactions are definitely recognized and can be controlled, the test should not be used to supplant the Wassermann reaction. It may be used profitably as a control for the Wassermann.

With regard to the Sachs-Georgi reaction in the spinal fluids, Harryman [80] finds that the results closely parallel those of the Wassermann. He believes that the test is a substitute, or may be used as a valuable addition to the spinal fluid Wassermann. It furnishes a means for an earlier diagnosis of syphilis of the central nervous system than does the Wassermann. Mandelbaum [81] believes that the substance responsible for the positivity of the Sachs-Georgi test is not albumin, nor globulin, but rather a member or members of the lipoid group.

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75. Epstein and Paul: Med. Klin. **17**:1118 (Sept. 11) 1921; abstr. J. A. M. A. **77**:1776 (Nov. 26) 1921.

76. Gloor: Schweiz. med. Wchnschr. **24**:466, 1920.

77. Taniguchi: Brit. J. Exper. Path. **2**:41 (Feb.) 1921. Taniguchi and Yoshinare: Brit. M. J. **2**:239 (Aug. 13) 1921. Kuner: Wien. klin. Wchnschr. **33**:562, 1920. Wolfstein: Berl. klin. Wchnschr. **56**:1110 (Nov. 24) 1919. Hull and Faught: J. Immunol. **5**:521 (Nov.) 1920. Messerschmidt: Deutsch. med. Wchnschr. **46**:150 (Feb. 5) 1920. Kilduffe: Arch. Dermat. & Syph. **3**:415 (April) 1921.

78. Parker and Haigh: Arch. Dermat. & Syph. **4**:67 (July) 1921.

79. Logan: Lancet **1**:14 (Jan. 1) 1921.

80. Harryman: Arch. Dermat. & Syph. **4**:299 (Sept.) 1921.

81. Mandelbaum: München. med. Wchnschr. **67**:962, 1920.

Some of the most important work on the phenomenon of serum-flocculation in the presence of colloidal solutions has been done by Vernes.[82] He outlines the method of the "Vernes" test, in which a colloidal solution, guinea-pig serum and red cells are used, with the formation of a colorimetric scale. Marie,[83] reviewing the subject, says that syphilitic serum induces flocculation a little faster than normal serum—that it is merely a question of degree in a general physicochemic phenomenon; and that Vernes' latest reaction is based on the superflaking properties of syphilitic serums as estimated with a standard opalescent scale. In Marie's opinion, it is scarcely probable that syphilis is the only disease that induces physicochemic changes in the serum; and evidence is accumulating that serum in tuberculosis and cancer may have a special action on suspensions of colloids. Cornwall and Aronson[84] believe that if confirmed the researches of Vernes will revolutionize the laboratory diagnosis of syphilis.

MISCELLANEOUS TESTS FOR SYPHILIS

The liquor formaldehydi test has not been found to be accurate. The test consists of adding a drop of ordinary liquor formaldehydi to serum without further dilution, and allowing the whole to stand for twenty-four hours at room temperature. Coagulation of the serum is a positive result. Suffern[85] believes that the test is not without value. Ecker[86] performed both the Wassermann and the formol reaction of Gates and Papacostas, in a series of 500 serums. He concluded that the formol reaction, as it stands, is of no diagnostic value because of its failure to react in clinically and serologically clear cut cases of syphilis, and because of the occurrence of positive reactions in the absence of the disease.

An interesting new serum reaction is the "sigma" reaction of Dreyer and Ward,[87] described by them as a "simple quantitative serum reaction." The authors maintain that it is more dependable than the Wassermann. The readings are expressed in terms of standard flocculation units.

Working on the speed of sedimentation of the red cells in infancy, György[88] found that in the citrated blood of infants of about 1 month, the red cells show a normal increase in the rate of sedimentation. In infants less than 1 month old, the average rate is very much slower.

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82. Vernes: Rev. neurol. **27**:156 (Feb.) 1920.
83. Marie, P.: Presse méd. **28**:856 (Nov. 20) 1920; abstr. J. A. M. A. **76**: 144 (Jan. 8) 1921.
84. Cornwall and Aronson: J. A. M. A. **75**:1697 (Dec. 18) 1920.
85. Suffern: Lancet **2**:1107 (Nov. 26) 1921.
86. Ecker: J. Infect. Dis. **29**:359 (Oct.) 1921.
87. Dreyer and Ward: Lancet **1**:956 (May 7) 1921.
88. György: München. med Wchnschr. **68**:808 (June 30) 1921.

In acute infections, tuberculosis, and especially in hereditary syphiiis, a further marked rise in the rate of sedimentation is found. When other causes of increased rate have been ruled out, the test can be made of real service in the diagnosis of hereditary syphilis. It parallels the Wassermann and Sachs-Georgi reactions.

Starting with the known fact that inactivation of serum increases its viscosity, Holke [89] found that prolonged standing at 56 C. increases the viscosity of serums of syphilitics, treated or untreated, negative or positive, more readily than that of normal persons with negative Wassermann reactions.

With regard to the luetin test, Ward [90] found 87 per cent. of positive luetin reactions in syphilitics. In a second series of 200 cases there were 75 per cent. corroborative returns. He says that luetin as a measure of the allergic reaction in syphilis has a higher reaction both negatively and positively than has been emphasized before. Luetin itself is in need of standardization and could easily be improved.

COLLOIDAL AND OTHER REACTIONS IN THE CEREBROSPINAL FLUID

Unquestionably the colloidal gold test has successfully withstood the manifold investigations to which it has been subjected. Articles endeavoring to show that it is of value seem no longer to be necessary. Articles explaining and interpreting its action are commonly encountered. Such an article is that of Cruickshank,[91] whose results confirm those of other workers. The substance in the spinal fluid of general paretics which causes the precipitation of colloidal gold is not dialyzable, and resides in the globulin fraction of the protein, and in this respect resembles the Wassermann reacting substance. It is not altered by heating to the coagulation point of protein. Syphilitic reactions are due to an amount of albumin sufficient to obscure partially the precipitating effect of the globulin. The precipitating action of paretic fluids cannot be ascribed solely to the increase in globulin, but is probably dependent on a specific alteration of the physical state of the globulin which is associated with a positive electrical charge.

Thompson [92] presents the results of 8,400 colloidal gold tests, made on about 7,100 cerebrospinal fluids at the Massachusetts State Psychiatric Institute. Six hundred and seventy-seven gave paretic curves. The author believes that a paretic curve points toward a parenchymatous involvement of the brain, while the milder gold curves are obtained in meningitis, vascular disease, etc. The paretic curve is

89. Holke: J. Path. & Bacteriol. **24**:413 (Oct.) 1921.
90. Ward: Am. J. Syphilis **5**:482 (July) 1921.
91. Cruickshank: Brit. J. Exper. Path. **1**:71 (April) 1920.
92. Thompson: Arch. Neurol. & Psychiat. **5**:131 (Feb.) 1921.

also of considerable prognostic value. Bonsmann [93] found that a negative colloidal gold test could be relied on as excluding central nervous syphilis. Multiple sclerosis and brain tumors are likely to give misleading findings.

Keidel and Moore [94] state that in view of the complicated methods of preparing reagents for the colloidal gold test, the simplicity and uniformity of the colloidal mastic test (first described by Emmanuel in 1915) has much to recommend it. Both depend on colloidal phenomena. The suspension of finely divided colloidal mastic particles undergoes quantitative flocculation, as in the colloidal gold test, also culminating in complete precipitation. The authors' results on the spinal fluids of 311 patients show close parallelism between the two tests. When agreement is lacking, the mastic test seems to detect abnormalities more frequently than does the colloidal gold test. This fact, together with the simplicity of the test, lead the authors to conclude that the mastic test should be an indispensable part of spinal fluid examinations. According to Stanton,[95] the results of investigators using the mastic test have been discordant. Certain samples of gum mastic which have been found to be entirely unsuited for use in the mastic test may explain the conflicting reports.

Cestan et al.[45] note that the "colloidal benzoin" reaction often remains positive when the Wassermann has been rendered negative by treatment. This test is more likely to agree with the globulin tests than with the Wassermann and cell count.

Hektoen and Neymann [96] advance a test which they maintain is a definite index of the amount of protein in spinal fluid. Antihuman rabbit serum is added to various dilutions of the spinal fluid. In paresis they found an increase in the albumin and globulin, chiefly globulin. In epilepsy the increase is in albumin.

SYPHILIS OF THE CENTRAL NERVOUS SYSTEM

Fortunately for the proper understanding of hereditary syphilis, more work is being done on the disease as it affects the central nervous system. As in adults, almost any neurologic condition may be simulated. Tabulating the details of 114 cases of inherited neurosyphilis, Mensi [97] calls particular attention to a girl of 8 who presented the complete clinical picture of cerebrospinal sclerosis. A girl of 7 presented the spastic paralysis with a tendency to obesity, described by Marfan.

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93. Bonsmann: Deutsch. Arch. f. klin. Med. **134**:20 (Oct. 26) 1920; abstr. J. A. M. A. **76**:901 (March 26) 1921.
94. Keidel and Moore: Arch. Neurol. & Psychiat. **6**:163 (Aug.) 1921.
95. Stanton: Arch. Neurol. & Psychiat. **4**:301, 1920.
96. Hektoen and Neymann: J. A. M. A. **75**:1332, 1920.
97. Mensi: Riv. di clin. pediat. **19**:1 (Jan.) 1921; abstr. J. A. M. A. **76**:1539 (May 28) 1921.

Psychic anomalies may be due to lesions of the nervous system, or to perverted functioning of the ductless glands.

Tilton [98] reviews the literature and reports three cases of cerebrospinal syphilis in one family. Undoubtedly, hereditary syphilis is responsible for some cases of idiocy and imbecility. Thom [99] believes that it is a most important factor. Haines and Partlow [100] found that of 672 children in Alabama industrial schools, 118 were feebleminded. They found no evidence of a high rate of syphilis among the mentally inferior. In a more intensive study of a smaller series, Raeder [101] examined thirty children from 2 to 16 years old, in either or both of whose parents there was a positive Wassermann reaction (blood). "Most of the parents" had neurosyphilis, usually of the paretic type. Nineteen of the children had positive blood Wassermann reactions. Spinal puncture was done on twenty-two of the thirty children. Four of the fluids were positive. In three of these the colloidal gold curves were paretic. In the children born nearer the parental infection, not only were the physical findings and the Wassermann reactions on serum and spinal fluid positive, but these children also showed a greater degree of mental deficiency. Children born later showed less mental defect. It will be seen from the studies reported that selection of the series is an important factor in determining the extent to which inherited neurosyphilis is responsible for mental deficiency.

Virtually all workers are agreed that early examination of the spinal fluid is of paramount importance, from the point of view of therapeutics and of prognosis. It is, of course, the only means by which an asymptomatic neurosyphilis may be discovered.[39] Bigland [102] says that without examination of the spinal fluid no case of organic central nervous disease should be considered syphilitic even when the blood Wassermann is positive. He also emphasizes that every case of organic central nervous disease requires spinal fluid examination even in the absence of suspected syphilis.

Kingery [103] studied the spinal fluid in fifty-two cases of hereditary syphilis. Fifteen, or 28.8 per cent. presented abnormal findings. There was a striking parallelism between the strongly positive Wassermann reactions and definite albumin and globulin increase; and an equally striking lack of parallelism between the degrees of pleocytosis and other strongly positive findings. There were four juvenile paretics and two mentally deficient cases in the series.

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98. Tilton: Northwest Med. **20**:251 (Sept.) 1921.
99. Thom: J. Ment. & Nerv. Dis. **53**:8 (Jan.) 1921.
100. Haines and Partlow: Ohio State M. J. **16**:515 (July) 1920.
101. Raeder: Am. J. Dis. Child. **21**:240 (March) 1921.
102. Bigland: Lancet **2**:687 (Oct. 2) 1920.
103. Kingery: J. A. M. A. **76**:12 (Jan. 1) 1921.

In an interesting article on tuberculous meningitis and hereditary syphilis, Hutinel and Merklen [104] note that they have seen the two diseases associated in more than twenty cases in the past few years. They consider it proper to assume that as hereditary syphilis is an important cause of meningeal dysfunction, the implantation of tubercle bacilli as well as other germs is thereby favored. It was not until the authors began doing Wassermann tests on all cases of tuberculous meningitis that they began to realize the frequency of the association of the two conditions. (These observations should be considered in the light of Cooke's observations [57] on cross-fixation in cases of tuberculosis and of syphilis. In any event the degree of positivity of the Wassermann is of great importance in its interpretation in tuberculous patients.)

Mingazzini [105] reports two brothers and a sister, all of whom began to suffer at puberty from a progressive motor disturbance of the lower extremities, terminating in the syndrome of family spastic paralysis. One of the brothers also suffered from optic atrophy, choroiditis and double cataract. The father of these children was a tabetic. With the exception of the first-born (contrast with Raeder's observations [101]) all his children were more or less deficient mentally. All were syphilitic.

From five cases which Ciuffini reports,[106] he warns that cerebral arteritis from inherited syphilis may develop with an onset like that in the acquired disease, and the course may be the same. In eight cases, nocturnal frontal headache was the main symptom of neurosyphilis.

Parker [107] reviews the literature on juvenile tabes and gives a summary of seven cases. He directs attention especially to the insidious onset, lengthy and even latent course of the disease, frequency of optic atrophy, of incontinence of urine; and the relative rarity of such striking phenomena as ataxia, girdle sensations and lightning pains. There is frequently a paretic termination. The large immobile irregular pupil is more frequent with juvenile tabetic patients, in contrast to the myosis and Argyll-Robertson pupil of adult patients. Of six spinal fluid Wassermann tests, three were negative though the blood was positive. (Bigland [102] would probably question the authenticity of these cases.) The observations of Rosenbeck [108] are in substantial agreement with those of Parker. He adds that the average age of onset of juvenile tabes is 15 years—a period equal to that between the primary lesion and tabetic manifestations in the adult. The prognosis in juvenile tabes is good for life, bad for vision.

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104. Hutinel, V., and Merklen: Arch. de méd. d. enf. **24**:521 (Sept.) 1921.
105. Mingazzini: Arch. Neurol. & Psychiat. **5**:637 (June) 1921.
106. Ciuffini: Riv. di patol. nerv. **25**:226 (Jan.) 1921; abstr. J. A. M. A. **76**:1375 (May 14) 1921.
107. Parker: Arch. Neurol. & Psychiat. **5**:121 (Feb.) 1921.
108. Rosenbeck: J. A. M. A. **76**:572 (Feb. 26) 1921.

An article by Kerr,[109] in which he reports a case of juvenile tabes in a boy of 14, serves to illustrate how, in point of signs and laboratory findings necessary to a diagnosis of juvenile tabes, authorities differ in their criteria. The striking manifestations in Kerr's case were: (1) "painful hip," which the author believed should be interpreted as lightning pains; (2) primary optic atrophy; (3) absent knee jerks. In Kerr's opinion, these manifestations established the diagnosis of juvenile tabes in spite of the absence of a history pointing to hereditary syphilis, in spite of the negative Wassermann reaction in both blood and spinal fluid.

An important article on juvenile general paresis is that of Toni Schmidt Kräpelin.[110] He reports thirty-nine cases of known juvenile paresis, including eight cases in which a wrong diagnosis was made, and seven cases of "preparalysis," in children who showed no clinical signs of metasyphilitic affection of the central nervous system, but in whom serologic findings characteristic of general paresis were more or less accidentally discovered. Over one fourth of the cases showed general arrest of development, one third were mentally deficient. Change in character was among the early signs. Acute onset with hemiplegia, epileptiform attacks and focal symptoms, appeared with relative frequency, suggesting a combination of epilepsy and brain syphilis. Optic atrophy without other tabetic symptoms was comparatively frequent. Total immobility of the pupil was more common than simple loss of the light reflex. In paralytic and preparalytic children, a peculiar hurried, toneless, and puffing manner of speech was noticed. Periods of excitement were common, but a persistent agitated condition was seen in only about 10 per cent. of the cases. The majority showed a typical Wassermann reaction in the blood serum and spinal fluid. No therapeutic results worth mentioning were obtained by any known treatment.

Dahlstrom [111] reports two cases of juvenile paresis, in one of which there was a misleading coincidence between trauma and the onset of the disease, with localizing neurologic signs which led to a considerable amount of brain surgery before the true condition was definitely established.

It is fortunately well-recognized that in both the acquired and hereditary forms of syphilis, infection of the central nervous system occurs early. The importance of early lumbar puncture has been urged for several years, notably by Klauder,[112] Fordyce,[113] and in the

109. Kerr: Lancet **1**:598 (March 13) 1920.
110. Kräpelin, T. S.: abstr. by L. J. Pollock, Am. J. Dis. Child. **23**:310 (Sept.) 1920.
111. Dahlstrom: Norsk Mag. f. Lægevidensk. **82**:710 (Oct.) 1921.
112. Klauder: Am. J. Syphilis **3**:559 (Oct.) 1919.
113. Fordyce: Am. J. M. Sc. **161**:313 (March) 1921.

case of hereditary syphilis, by Jeans.[114] Fordyce considers it probable that the *Spirochaeta pallida* invades the nervous system during the period of general dissemination or not at all. Wile and Hasley[115] believe that when positive findings in the spinal fluid precede the changes in the blood, such a condition must be due to the greater delicacy of laboratory findings in the spinal fluid. Such results cannot be considered evidence for neurotropism. The authors' findings thus substantiate for the human host the observations of Brown and Pearce for dissemination in the rabbit.[15]

Both Bambarén[116] and Savory[117] urge the importance of investigating cases with epileptiform seizures for the presence of syphilis, hereditary or acquired. The former believes that the evidence is strongly against the idea of Strümpell that inherited syphilis has never been shown to be a factor in epilepsy. He cites Levy-Bing's thirteen cases of essential epilepsy, with a history of syphilis in all.

With regard to the accuracy of the blood Wassermann in neurosyphilis, Hanssen[118] found that 13.5 per cent. of 105 patients with neurosyphilis had a negative Wassermann in the blood, but a positive one in the cerebrospinal fluid.

An experimental observation which may have some therapeutic significance is that of Weston.[119] Working with seventeen cases of general paresis, he found that after the intraspinal injection of 1 c.c. of phenolsulphonephthalein, it took the dye from twelve to sixty-eight minutes to appear in the urine—the time in normal subjects being from four to ten minutes. As the dye was not found in fluid drawn from the cisterna magna at any time up to five hours, the author concluded that absorption in these cases took place in the lumbar region. Whether these facts might account for the practical futility of intraspinal therapy in paretics, remains to be seen.

SYPHILIS OF THE EYES

Green's first article on this subject has been reviewed by Jeans.[1] In his later publication,[120] the literature is reviewed and complete statistics given for each form of ocular disturbance encountered in the 100 cases studied by him. Particular mention should be made of the

114. Jeans: Am. J. Dis. Child. **18**:173 (Sept.) 1919.
115. Wile and Hasley: J. A. M. A. **76**:8 (Jan. 1) 1921.
116. Bambarén: Siglo méd. **68**:485 (May 21) 1921; abstr. J. A. M. A. **77**: 497 (Aug. 6) 1921.
117. Savory: Lancet **2**:296 (Aug. 7) 1920.
118. Hanssen: Acta med. Scand. **53**:748 (Jan. 14) 1921; abstr. J. A. M. A. **76**:903 (March 26) 1921.
119. Weston: Arch. Neurol. & Psychiat. **5**:58 (Jan.) 1921.
120. Green: Am. J. Dis. Child. **20**:29 (July) 1920.

nineteen cases of present or past interstitial keratitis (bilateral in seventeen cases) and of the fact that fifty-two of the 100 cases presented undoubted eyeground lesions. Fourteen different types of eyeground pathology are recorded, the most characteristic being peripheral and central punctate pigmentation. Papillary haze, or "veiling" of the optic nerve head was also quite common. Occasionally the intra-ocular lesion may be the only manifestation of the hereditary syphilis.

In the course of a comparative study of syphilis in whites and negroes, Zimmermann [121] has the following to say about the hereditary cases. Only the late forms of hereditary syphilis are treated in the syphilis clinic of the Johns Hopkins Hospital Dispensary where 60 per cent. of the patients are colored. No noteworthy difference between the two races with respect to late hereditary syphilis was found. Interstitial keratitis occurred in 33.3 per cent. of the white males, and in 61.7 per cent. of the white females; in 35.7 per cent. of the colored males, and in 75 per cent. of the colored females. Such predominance of keratitis in the female has been noted frequently.

Baldino [122] reports an unusual case of bilateral congenital cataract, with marked opacity of the crystalline lens in a case of hereditary syphilis with a positive Wassermann, saddle nose and Hutchinson's teeth.

SYPHILIS OF THE AUDITORY SYSTEM

In a Wassermann survey of twenty-three deaf mutes, thirteen were found to be positive by Ardenne.[123] The test was positive in eight of eleven congenital cases, and in five of twelve cases in which some disease was responsible for the deafness.

Ramadier [124] gives an illustrated description of a pneumatic (Hennebert's) test of the vestibule, a positive response being nystagmus or a slow movement of the eyeballs under compression or aspiration of the air in the external ear. This "sign of a fistula without a fistula" is evidence of some lesion in the internal ear alone, and this is comparatively common with inherited syphilis. The writer never found this test positive in the normal ear, nor in other forms of ear disease. No case has yet come to necropsy, but a specific osteitis of the bony capsule of the labyrinth would explain the clinical manifestations. The test is applied with a speculum and a rubber bulb. Hennebert [125] reports three cases of deafness due to hereditary syphilis. The first

121. Zimmermann: Arch. Dermat. & Syph. **4**:75 (July) 1921.
122. Baldino: Riforma med. **36**:833 (Sept. 11) 1920.
123. Ardenne: J. de méd. de Bordeaux **91**:379 (July 25) 1920.
124. Ramadier: Presse méd. **29**:624 (Aug. 6) 1921; abstr. J. A. M. A. **77**: 975 (Sept. 17) 1921.
125. Hennebert: Arch. Ital. di Otol. Rhinol. e Laringol. **31**:198, 1920; abstr. Am. J. Syphilis **5**:159 (Jan.) 1921.

two constitute the classical picture of hereditary syphilitic labyrinthitis. The onset of the deafness in the first case dated back to early infancy, in the second to the age of 15 years. In one of the author's cases deafness did not begin till the age of 36 years, the case being a bona fide one of hereditary syphilis. As a rule, the deafness is very pronounced. Kay [126] reports nerve deafness due to hereditary syphilis in three children in one family, their ages being 7, 5 and 4 years. In each case the evidence of the disease was manifest between the first and second years. The Wassermann was positive in the oldest child and in the parents.

TEETH

Davidsohn [127] cites the findings of Hutchinson and Neumann as to the frequency of hypoplasia of the deciduous teeth in hereditary syphilis. Such hypoplasias are also to be found in other constitutional diseases. Knowledge of their occurrence in the milk teeth of healthy, rachitic and constitutionally sick children is essential to their correct evaluation in syphilitic children. Davidsohn is convinced that true Hutchinson's teeth are pathognomonic of the disease. Though less frequent, and seldom mentioned in the literature, the enamel defects of the permanent lower central incisors may be important manifestations of hereditary syphilis. Alterations in the entire dental morphology are noted. Whether narrow, slender teeth, with large defects, are to be regarded as in the same group as Hutchinson's teeth, is not yet determined, though this conception is not without foundation. Davidsohn and Davidsohn,[128] studying fifty cases of hereditary syphilis in children more than 6 years old, found Hutchinson's teeth in twenty-four, or 48 per cent.

Sabouraud [129] says that dental stigmata often reveal otherwise unrecognized hereditary syphilis. He emphasizes the fact that certain dental buds do not develop, and that the superior lateral incisors are more likely to be lacking—or even the four lateral incisors, both upper and lower. Sometimes the cutting edge is indented. This striking deformity has been noted on one jaw in all the teeth up to the premolars. "Fish-teeth," i. e., very narrow, sharp teeth, are among the many lesions described. Enamel defects of the molars are also considered frequent. Some molars may be found with five cusps instead of four—others, which have on the internal surface the "embryo of a fifth cusp"—the so-called "tubercle of Carabelli," or mammillary eminence. Sabouraud urges that in view of the permanence and

126. Kay: J. A. M. A. **74**:1162 (April 24) 1920.
127. Davidsohn, E.: Ztschr. f. Kinderh. **25**:249, 1920.
128. Davidsohn and Davidsohn: Deutsch. med. Wchnschr. **47**:1064 (Sept. 8) 1921; abstr. J. A. M. A. **77**:1775 (Nov. 26) 1921.
129. Sabouraud: La Médecine **2**:105 (Nov.) 1920.

importance of the dental signs of hereditary syphilis, all physicians should acquaint themselves thoroughly with them.

HAIR

In an article on the relation between alopecia areata and syphilis, Sabouraud [130] states that though many cases of alopecia areata occur without demonstrable syphilitic taint, the proportion of patients with inherited syphilis is too large for a casual coincidence. His numerous experiences with the cure of alopecia areata in children under treatment for syphilis corroborate the relation between them.

CIRCULATORY SYSTEM

There has been a marked increase in the contributions to this phase of hereditary syphilis during the past year and a half. It is interesting that in 183 Wassermann tests on eighty-four children of school age with heart disease, only one test was positive.[131] (Allowance must, of course, be made for the social status of the children studied, the time between the Wassermann test and parental infection, etc.) Hahn [132] claims to have demonstrated that the majority of cases of vascular neuroses in children are referable to hereditary syphilis and to syphilitic injuries to the fetus—a claim as yet unconfirmed by other writers.

With regard to aortitis, so common in adults with the acquired disease, Stolkind [133] was unable to find a single instance, in the literature, of definitely proven heredosyphilitic aortitis in older children or adults, though he does not doubt the existence of such cases. He cites a case of his own with Hutchinson's teeth, positive Wassermann, etc., with aortic regurgitation and considerable cardiac involvement, which necropsy showed to be a case of serofibrinous pericarditis with verrucous endocarditis of the aortic and mitral valves. The author insists on the difficulty of excluding cardiac lesions other than syphilitic.

Calvin [134] reviews thirty-one cases of thoracic aneurysm in children, and presents two cases of his own. He thinks the evidence far from conclusive that syphilis is the sole or even the common cause of aortic aneurysm in childhood. In fact, the greater number of these cases are due to other causes, such as infectious aortitis, erosion from without, and congenital malformations. In the first of a series of studies of aneurysm, Lucke and Rea [135] state that in 247 patients, the

130. Sabouraud: Presse méd. **29**:581 (July 23) 1921.
131. Donaldson: New York State J. M. **21**:176 (May) 1921.
132. Hahn: Zentralbl. f. inn. Med. **42**:601 (July 30) 1921; abstr. J. A. M. A. **77**:1295 (Oct. 15) 1921.
133. Stolkind: Brit. J. Child. Dis. **17**:126 (July-Sept.) 1920.
134. Calvin: Am. J. Dis. Child. **21**:327 (April) 1921.
135. Lucke and Rea: J. A. M. A. **77**:735 (Sept. 17) 1921.

youngest was 12 days old, the oldest 91 years. More detailed pediatric data are not given in this study.

Queyrat and Mouquin [136] found signs typical of aortic stenosis in a boy of 5, whose father had congenital cataract, considered by Cantonnet to be due to hereditary syphilis. The difficulty of definite proof that such lesions are really syphilitic has been shown by the preceding articles. The same statement is true of the mitral lesions.[137] With regard to the myocardium, Friedlander [138] is of the opinion that in many instances myocardial degeneration in infancy and early childhood rests on a basis of hereditary syphilis. There is no typical form of myocarditis which might be recognized as syphilitic. In cases of heredosyphilitic myocardial degeneration, rapid improvement has followed intensive antisyphilitic treatment.

KIDNEYS

Discussing the evolution of acute nephritis in hereditary syphilitics, Queslier [139] reports finding in the literature 101 cases in which the specificity of the nephritis was established by the avowal of the parents, stigmata of the inherited disease, and positive seroreaction. Seventy-three patients were less than 2 years of age, while the remainder were of all ages up to 23 years. In all cases other prominent causes of nephritis were excluded. Only six of the seventy-three infants survived the disease, while of the twenty-nine older individuals, eighteen succumbed to the nephritis. All varieties of nephritis were found. The acute parenchymatous type was common clinically, though, strange to say, not encountered at necropsy. Naturally, renal symptoms are often masked by extensive lesions in other organs. Rolleston [55] believes that the chronic interstitial type of nephritis in early life is not so frequently due to hereditary syphilis as was formerly thought.

BONES

Gaenslen and Thalhimer [140] contend that our knowledge of heredosyphilitic epiphysitis is incomplete, and question the commonly accepted conception that this condition occurs only in the early months of infancy. They report a case of epiphysitis in the greater trochanter of the femur of an adolescent boy, and attribute the lesion to hereditary

136. Queyrat and Mouquin: Bull. et mém. Soc. méd. d. hôp. de Par. **45**:1152 (July 21) 1921.

137. Babonnei and Denoyelle: Bull. et mém. Soc. méd. d. hôp. de Par. **45**: 774 (June 2) 1921. Amblard: Bull. et mém. Soc. méd. d. hôp. de Par. **45**: (May) 1921. Merklen: Bull. et mém. Soc. méd. d. hôp. de Par. **45**:815 (June 9) 1921.

138. Friedlander: Gaz. d. hôp. **93**:64 (July 20) 1920.

139. Queslier: abstr. in Arch. Pediat. **38**:450 (July) 1921.

140. Gaenslen and Thalhimer: J. Orthoped. Surg. **3**:8, 1921.

syphilis because of (1) predominance of cartilage and the riotous appearance of the process of osteogenesis; (2) lack of completion of bone formation; (3) excess of calcium deposit in the cartilage which is in apposition to the areas of bone formation; (4) the obliterating endarteritis in the thickened periosteum.

LYMPH NODES

Fabris [141] reports the results of examination of 2,605 infants for enlargement of the epitrochlear glands. In children who presented signs of inherited syphilis, epitrochlear enlargement was evident in 32 per cent. of those under 1 year, and in 33 per cent. of those up to 2 years of age. The figures were only 7 and 9 per cent. in tuberculous children, and 7 and 11 per cent. in those with rickets. Epitrochlear adenitis, therefore, may be regarded as a confirming sign in inherited syphilis, to judge from the author's 379 cases with the inherited taint.

DYSTROPHIES AND CONGENITAL MALFORMATIONS

Hutinel and Stevenin [142] name three varieties of dystrophies which are of importance in connection with hereditary syphilis: (1) the partial, local, infectious—due directly to the lesions of the disease itself—as for example the bone lesions; (2) general dystrophies, attributable to impaired function of the organs affected—particularly the endocrine glands (a theory concurred in by Barthélémy). Such cases should be treated by organotherapy as well as by antisyphilitic drugs. (3) Hereditary dystrophies due to transmission from parents to children of "organic debilities"—to the second and third generation, as for instance hyper- and hypo-thyroidism.

In the Naples children's clinic, de Stefano [143] investigated all cases with congenital anomalies. There was an overwhelming preponderance of syphilis in the antecedents of all except the cases of spina bifida.

Rios and Bisso [144] report a "monster from inherited syphilis." O'Brien and Mustard [145] quote Socin's report of a case of phocomelia with death occurring seventeen days after birth, of hereditary syphilis. A heredosyphilitic gynandroid is also reported.[146] Queyrat's observations on malformations of the xiphoid in hereditary syphilis are well known. Malformed spermatozoa in heredosyphilitics have already been mentioned.[25] Clément Simon [147] also reports a case with this condition.

(To be continued)

141. Fabris: Pediatria **29**:193 (March 1) 1921; abstr. J. A. M. A. **76**:1435 (May 21) 1921.
142. Hutinel and Stevenin: Arch. de méd. d. enf. **23**: Nos. 1, 2, 3, 4.
143. de Stefano: Pediatria **29**:59 (Jan. 15) 1921.
144. Rios and Bisso: Semana méd. **28**:175 (Aug. 11) 1921.
145. O'Brien and Mustard: J. A. M. A. **77**:1964 (Dec. 17) 1921.
146. Laiguel, Lavastine, and Boutel: Bull. Soc. méd. **43**:754 (May 28) 1920.
147. Simon: Bull. Soc. franç. de dermat. et syph. No. 6, 193, 1921.

BOOK REVIEWS

THERAPEUTISCHES VADEMEKUM FÜR DIE KINDERPRAXIS. By Prof. Hans Kleinschmidt. Berlin, S. Karger. 1920. Ed. 3. Pp. 196.

This book is a small compendium of treatment and covers very completely the conditions seen in children. The author discusses systematically general symptomatic therapy, feeding of healthy children, disturbances of nutrition, and the diseases of the new-born, of infants and of older children. Wherever possible, the question of prophylaxis is also considered. The directions are simple, clear and concise. For American readers, however, the book has the disadvantage of recommending certain proprietary remedies, which are not familiar.

UEBER KLINIK UND EPIDEMIOLOGIE DER PERTUSSIS. By Von Dr. D. Pospischill. Berlin: S. Karger, 1921.

A complete and detailed account of the symptoms and treatment of whooping cough based on a large hospital experience in Vienna. After a long introduction he takes up the question of the pertussis lung. Characteristic of this are areas of bronchial breathing which change their location from day to day. This leads to many complications. In relation to tuberculosis as a complicating factor, the author states that in many thousands of necropsies on whooping cough cases, he is convinced that tuberculosis is proportionately very little influenced by whooping cough, and there are an extremely small number of florid processes in his experience. In other words, where pertussis complicates tuberculosis, the resulting death is from the pertussis and not from the tuberculosis. Also, where pertussis, measles and influenza are grouped together, the result does not seem to be materially influenced by measles, but measles seem to act as a connecting link to produce fatal results. He thinks that in large measure lung diseases in children have their origin in whooping cough, at least that has been his experience in his hospital.

He then details the various complicating lung affections of whooping cough. He discusses the effect of measles complicating whooping cough. Measles seem to act by sharpening the symptoms of whooping cough and even though several years may have elapsed between the whooping cough and the occurrence of measles, there is still evidence of the effect of the whooping cough on the lungs. Measles may lead to a recurrence of whooping cough. The effect of other infectious diseases is taken up and given in detail.

A discussion of the brain in pertussis with a detailing of the various pathologic conditions arising during the course of the disease is taken up in detail; then the vascular system, and finally pertussis pyemia, with another chapter on accidental infections occurring in pertussis. His chapter on treatment is composed largely of the prophylaxis. He believes that the best treatment for pertussis is the open air treatment winter and summer. In their hospital they have an open air pavilion in which the pertussis cases are placed.

The book is extremely detailed, perhaps too much so for a casual reader on the subject, and unfortunately, it does not possess an index, which would help one greatly in looking up a specific phase of the condition. There are a few illustrations demonstrating certain clinical features of the disease.